Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA.

VOL. XLI. No. 17. NEW YORK, SATURDAY, OCTOBER 25, 1902. ISSUED WEEKLY

ELECTRICAL REVIEW

13 to 21 Park Row NEW YORK

BY THE

ELECTRICAL REVIEW PUBLISHING COMPANY

CHARLES W. PRICE . . . . PRESIDENT and EDITOR
STEPHEN H. GODDARD . SECRETARY and MANAGER
RUSSELL HOWLAND . GENERAL REPRESENTATIVE
WM. HAND BROWNE, JR. . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

WESTERN OFFICE — 40 Dearborn Street, Chicago, Ill.
LONDON OFFICE — 42 Old Broad Street, London, E. C.

TELEPHONE CALL (private branch exchange connecting all departments) — "21 Cortlandt."
REGISTERED CABLE ADDRESS — "Electview," New York.

To Advertisers

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

Subscriptions

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	10
Copies supplied for only one year back, each	25

ELECTRICITY DIRECT FROM COAL.

One of our New York daily contemporaries—*The Tribune*—devotes a half-column editorial to a cautious—and very properly so—discussion of a report from Chicago to the effect that Mr. Hugo Jone, the city chemist, expects to solve the great problem of direct conversion of the energy of coal into electrical energy.

The problem is a very important one, and far be it from us to discourage Mr. Jone in his praiseworthy undertaking. Reports, however, seem to show that Mr. Jone is working along old lines. The use of lead and sulphuric acid is not new, and we do not believe that any process which consumes other materials in addition to the carbon can be successful, even though the by-products have a commercial value. Work which has already been done in this line seems to indicate that entirely new methods are required, and we would therefore advise all who attack this problem to make themselves thoroughly familiar with the work which has already been done in this direction.

PERPETUAL MOTION SCHEMES.

The perpetual motion crank is abroad in the land and is securing all the advertising and notoriety he wishes from the daily press. The more or less sensational articles which one sees in his morning paper must be attributed to one of two causes—either the paper which publishes at length such stories as facts knows no better, or it wilfully lends countenance to these absurdities, to call them by no harsher name. Out of charity one is inclined to accept the first alternative.

It is only a few years since Keeley died, and he managed to deceive many even to the last and waste thousands of dollars of other people's money. Who can say how soon another perpetual motion schemer will gain the confidence of the public, and live a life of ease at the expense of others. We have heard lately of a Kansas farmer who has built a machine which, through the agency of a coiled spring, runs on forever; and not long since did an instance come to our notice where a man who had been an official of a certain street railroad made some elaborate drawings of a perpetual motion machine, using the old weight and lever idea, and on the strength of these drawings and his skill in talking secured a good deal of money from the employés of the company.

All such frauds could be exposed, if not prevented, by the daily press, which should feel some responsibility in this regard.

One of the latest stories of this type tells how two Bible students, by thorough application to their studies, have discovered a new "force" which is far more "subtle" than electricity, and the story goes on to say that at present they are dividing their time between their studies and the building of a machine which will utilize this new power.

We would suggest that these students concentrate their whole energy on their Bible study. This can not harm them, and may even be of benefit, while the race will lose nothing thereby.

The unscientific can not learn too soon that great discoveries are not made in this way, but result from careful and patient study of nature. Galvani spent twenty years before he discovered the proper conditions to make the frog's leg kick. There was a lapse of over ten years before the reversal of Oersted's phenomenon was accomplished by Faraday, and another period of over forty years before his discovery was put to practical use. Roentgen's discovery of the X-rays, though unexpected, was the result of long and careful study of vacuum tube phenomena. To pore over a book and evolve scientific laws from one's inner self harks back to the methods pursued by the so-called philosophers of the pre-Baconian school.

AVOID COLLISIONS.

Enthroned upon a dray burdened with a massive boiler which overhung at the rear, he drove in the full confidence of plenteous power and adequate resistance begotten by the pull of six horses in front and staunch hubs underneath. He neglected to hasten in crossing the route of a trolley car, whose motorman treated the dray as contumaciously as if it had been merely the President's barouche, and crashed into the load with a resounding whang which furnished a diapason to the crash of glass amid cries of the scared.

The drayman continued serene, and pulling the team to a standstill, enquired, "Did you think I was a pneumatic sulky?"

In the applications of electricity we find the counterparts of the vehicles along the streets, the big hubbed drays, the street cars, wagons and carriages, even to the pneumatic sulky. These vehicles have rights of passage, which entail an equal obligation to concede the same prerogatives to others.

All vehicles have rights based upon the

necessities of civilization, and the applications of electricity have rights based upon the same higher law.

The distribution of electricity includes privileges of occupancy, rights of property and authority of franchise, and there are none to deny their right to existence. But as on the highway passers-by must turn to the right, and the big hubs of the heavy teams respect the spider-web pneumatic sulky, it is equally imperative in affairs electrical that collisions should be avoided.

Each plant, for whatever class of electrical service, is proportioned in the uttermost detail for its specific functions and the imposition of other currents is at least a disturbance of the service and generally causes a disablement of one or both systems.

The contact of an electric lighting or power wire with a telephone circuit may not injure the tiny apparatus, thanks to the protective devices, but it stops the telephone service on that line until the safety appliance is renewed. The same cross, however, may cause serious injury to the central plant of the lighting or power system.

This problem of the interference of electric circuits with each other has not received the careful consideration which it deserves, but it carries its own solution.

Protective devices are confessed makeshifts providing for the destruction of a relatively cheap and easily renewable portion of the plant, but they do not prevent interference with the service.

"John," said the retired lawyer to his coachman, "aren't the horses trying to run away?" "They be, sir!" "Then drive into something cheap."

The problem of providing for the incidents consequent upon the collision of conductors must be treated from the standpoint of prevention. The wires must be held securely in their own positions, and these are questions of construction.

Staunch poles, renewed when inspection reveals defects; guys where need be; guard wires where required by the proximity of other wires; proper separation between the various underground conductors are well known and usual methods of construction which, if adhered to, will avert difficulties. Mishaps will happen, but they must be minimized, and for such exceptions the protective apparatus has its place.

The commerce in electric energy is a hand-to-mouth trade, and the electric companies concentrate every effort upon continuity of service.

The initiative in these matters must come from the source from which all protective devices and methods have originated, and that is from the manufacturers of electrical apparatus whose zeal for a good name has spared no pains to remove any cause for the deviation of their work from its designed purpose.

A natural centralization of measures designed to maintain the normal operation of the various classes of electric service might be expected through the Institute of Electrical Engineers in the codification of the best practice into a concrete form.

It is an open question whether the limitations of the underwriters to ensured property might not prevent them from enforcing rules pertaining to an exterior hazard along the highways. Moreover, the duties of municipal electricians have limitations both as to functions and territory. Yet we claim that any method of installation of plant and erection of lines set forth by the Institute of Electrical Engineers would be fully accepted as a standard to be followed by the designing engineer, following in this respect the fealty shown to reports of similar nature issued by the mechanical societies, and which have fixed the standards in boiler construction, engine testing, sizes of pipe, dimensions of fittings and details of car construction.

That electrical interests will be well represented at the World's Fair, at St. Louis, 1904, there is no doubt. After listening to Dr. W. E. Goldsborough, chief of the electricity department, at its recent convention in Detroit, Mich., the American Street Railway Association adopted resolutions commending the activity of the commissioners and voted its support as an organization. This is in line with what several organizations of allied electrical interests have already done. With the representative bodies which have now evidenced their complete accordance with the plans outlined by the chief of the electricity department, there seems to be no reason why the electrical field in general should not come heartily to the front as a factor in making this occasion a thorough exposition of electrical development.

NEEDED ELECTROMETALLURGICAL PROCESSES.

Despite our rapid advances in electrochemical and electrometallurgical arts there still remain several old and important problems to be solved, which offer to the developers of successful processes large fields for profitable application.

The need for a method for the direct conversion of the chemical potential energy of coal into electrical energy has been so thoroughly discussed in recent years that we need not dwell longer upon it. The storage battery problem likewise needs no reminder at this time, particularly as it is receiving careful study.

Two problems which we have particularly in mind come under the head of metallurgy, and although many attempts at their solution have been made, so far as we are at present aware, no satisfactory process has yet been evolved. One of these is the need of an economical electrometallurgical process for extracting copper from sulphide ores. These are the most important of the copper ores, and the metallurgical methods at present in use involve five, or even seven, stages. It would appear that there is here room for a totally different method of reduction, involving fewer operations.

In copper refining there is generally less than one per cent of impurities to be dealt with—a very exceptional condition. In treating ore directly, thirty per cent or more must be contended with, this being largely sulphur and iron. Some of the earlier attempts may be mentioned briefly. The Marchese process consisted in smelting the ore in the usual way. This was then cast into plates and used as anodes. These plates were found to be very brittle, and became covered with a layer of sulphur under the influence of the electrolyzing current. The electrolyte was an acid solution of copper and iron sulphates. The difficulties encountered resulted from the large amount of impurities present and the high electromotive force which was found to be necessary to continue the operation after the anodes had been in the baths for a short time.

Body's process differed from the above in the method of obtaining copper in so-

lution. The ore was placed directly in the electrolyzing vats and leached with a solution of ferrous and sodium chlorides. The current is passed between an anode of carbon and a copper cathode, and the ore was kept stirred. The Siemens & Halske process differed but little from Body's, except that the ores were leached outside of the electrolyzing vats and a diaphragm was placed between the two electrodes. Hoepfner, Cohen and others have worked over the problem, but apparently without success. The great difficulties met with in these processes arise from the cost of crushing the ore. The solution becomes very impure; the diaphragms, when used, are expensive and not durable, and the anodes give trouble.

Another opportunity for a successful electrical process lies in the great deposits of zinc and lead ore. Both of these metals are in demand, and both are rather expensive. Vast deposits exist in Australia, which are easily mined. The upper layers of these deposits have been oxidized by the weather, and a greater portion of the zinc washed away. The residual material, consisting principally of lead, and bearing some silver, has been worked over. These upper layers have finally been exhausted, and further economical work has been impossible.

Here, also, a number of attempted solutions have been made, probably that proposed and tried by Ashcroft being the best known. The ore, consisting of galena and zinc blend, was ground, then roasted, and leached in a solution containing zinc sulphate, zinc chloride, ferric sulphate and ferric chloride, and in this way the zinc was removed. The residue from this process, containing all the lead and silver, was treated to separate these. The solution containing the zinc was electrolyzed between an iron anode and a zinc cathode. This threw down the zinc in a spongy condition, for which there was little sale. The process was a continuous one. It was given a fair trial and abandoned.

Dieffenbach roasted the ore with common salt and then leached it with water. Hoepfner used a solution of zinc and other chlorides. Swinburne crushes the ore and feeds it in an externally heated cauldron containing molten lead and molten zinc chloride. The lead takes up the silver and is drawn off and treated in the usual way. The lead and zinc salts are electrolyzed, bringing down first the molten lead and next the zinc. Cowper-Coles crushes and roasts the ore and then leaches it with sulphuric acid and zinc sulphate. The solution is then electrolyzed between a lead anode and an aluminum cathode. None of these methods has been successfully applied.

A careful study of such problems as these may result in developing some successful method. One should not be discouraged by the fact that good men have already studied the question. The early attempts at electrolytic copper refining were failures, while it is only within the last few years or so that the cyanide process for the extraction of gold was applied successfully.

MACHINE TOOL PROGRESS.

With this issue we present the first chapter of a series of articles on machine tool progress. In a great many cases, the product of the manufacturer as it comes from the works a finished article is looked to as an object of admiration, and often the wonder is expressed that the apparatus in its entirety is a human possibility. The completed article of to-day is repeatedly compared with that of but a short time ago, and its remarkable progress in construction and design is continuously commented on. All this improvement, however, waits entirely upon the ingenuity of the machine tool maker. He it is who is responsible for the giant structures which we see to-day, and to his genius must be laid the credit for making possible the consummation of the ideas of master minds and creative geniuses. A number of machine tool designs have held to original ideas with but slight modifications, the trend being only in the matter of making heavier machines, and at the same time making them capable of doing a finer class of work and operating at greater speeds. But in the majority of cases the old types of machines are the ancestors of a wide variation of combinations, the vital principles of the initial machine being in many designs the only thing recognizable in the modified tool.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

ACCIDENTS DUE TO ELECTRICITY IN PRUSSIAN COAL MINES.

A state paper has recently been issued giving the list of accidents in Prussian coal mines and some remarks upon them. The accidents are of a very general character, but they rather strikingly illustrate the fact that the British and American miner is by no means more stupid than his German confrère. Seeing that technical education is supposed to be so much more developed in Germany than at any rate in England, this is a somewhat startling feature of the report.

BURNING OF THE HAND DUE TO STUPID CURIOSITY.

In this accident, so-called, an electric motor worked with three-phase currents at 550 volts was fixed in a cabin, which was kept locked up, in the ordinary way. One day the cabin happened to be left open, and a workman, a stranger to the mine, walked into the cabin and touched the bars of the tripolar switch, with the result that his hand was very badly burnt. The report says that the hand was completely burnt, but it is not certain if the whole hand was destroyed, as in a fire, or rendered temporarily useless, as is more frequent in cases of this kind. This accident reminds the writer of a somewhat similar one that occurred in one of the corporation electric supply stations in Lancashire. The switchboard attendant, having not much to do, amused himself by throwing a piece of fuse wire into the air and catching it in his hand as he would have done a ball in his school playground. After this had gone on for a little time the fuse wire fell across a pair of terminals on the switchboard, between which the full difference of pressure of the service existed. The fuse wire was immediately converted into vapor with a blinding flash, and the larker's eyes and hand were considerably damaged.

AN ACCIDENT DUE TO THE USE OF 3,000 VOLTS DIRECTLY TO A MOTOR.

In this case the motor was driving an excavator, and a portion of the ironwork of the machine made contact with the service wires, which were at 3,000 volts. The attendant, on taking hold of his lever to actuate the machine, received a shock which killed him. This accident emphasizes the controversy that has taken place over the matter of the pressure that

is to be used in mines. On the Continent of Europe it is quite a common thing to take a pressure of 3,000 volts alternating directly into the mine, utilizing the current at that pressure for pumping and other work. So far the impression has been that the use of these high pressures has resulted in no more accidents than the use of the standard 500 to 550 volts. In America, as will be known to the readers of the ELECTRICAL REVIEW, the tendency is very strong to reduce the pressure of the service in use in coal mines from 500 volts to 250 volts. On the other hand, in the United Kingdom, events are trending slowly to higher pressures. In a case in Yorkshire, on which the writer was recently employed as consultant, where a large power was required for haulage purposes at a long distance from the shaft bottom, he found that the cost of cables on the 500-volt supply system would be so enormous that he felt obliged to advise that a pressure of 2,000 volts should be taken into the mine and transformed down to 100 volts for the haulage motors. His view is and was that the arrangement he laid out will be safer than the 500-volt system. He was careful to specify that the 2,000-volt cables were to be kept to the intake air-ways, where no gas is present, and that no one was to touch them on any consideration except the man in charge, or some one authorized by him, and for whom he would be responsible. In the writer's opinion, it will be absolutely necessary to make use of high-tension currents in some such manner as this if electricity is to continue to be employed for mining work, in consequence of the great increase of the distances over which power has to be delivered and the great increase of the power required. In the case mentioned above, the writer calculated that the difference in cost of cables on the lines which he specified, and on a 500-volt service, was approximately £7,000.

THE INSULATION OF CABLES, ETC., IN MINES.

One point that should be noted, in connection with the accident described above with the 3,000-volt service, is that apparently the conductors were naked. In the writer's opinion, the use of naked conductors about any coal mine is strongly to be deprecated. The writer is aware that naked conductors have been largely used about coal mines, especially in America, and that accidents have not been, he believes, unduly frequent; but he takes it that the strong feeling entertained by American mining engineers in favor of a lower voltage is corroborative of his view. High voltages can be used with safety wherever insulation can be ensured, and the danger of using high pressures is not the pressures themselves so much as the difficulty of insulating for those pressures.

THE MECHANICAL STRENGTH OF INSULATION.

Another point that, in the writer's opinion, is too little regarded, not only in mining circles, is the mechanical strength of the insulation provided. Many of the accidents which arise are due to the insulating envelope having been cut through or worn through, and the conductor it was intended to protect being brought into contact with some metal, such as a bracket or, as in the case under notice, some portion of the machine actuated by the electric motor, which thereupon becomes alive with full pressure of the service. This is particularly of importance in mining work, as electrical conductors are so subject to rough usage and so liable to have the insulating envelope stripped off, while, on the other hand, the seam often makes very good earth. It only means a little more expense, which would be more than recouped in the avoidance of accidents, etc.

DEATH FROM 110 VOLTS, ALTERNATING.

This is the first genuine case the writer has met with of death from a shock at 110 volts, alternating. The case recorded occurred in the Concordia mine, at Oberhausen, in Prussia. There is a service at the mine of 110 volts, alternating, at the generating station, which is transformed down to 200 volts for power and 110 volts for light. The lighting was by sixteen-candle incandescent lamps. A workman was engaged in attending to a particular lamp underground. The lamp was fed by a pair of wires one millimetre in diameter, covered with rubber, and with impregnated jute overall, and the wires leading to the lamp were coiled up in a spiral of three millimetres in diameter in the usual way, the spiral being further protected by a covering of rubber and cotton impregnated with compound. The reason why the man was killed does not seem to be at all clear. He was seen by two other workmen attending to the lamp as they passed him, and shortly after, on their return, he was calling out for them to turn off the current, he being then lying on the ground. The two workmen went to the machine house, which was about a quarter of a mile away, and instructed the attendant to switch the light off. The attendant did not appear to have understood. At any rate, on the return of the two workmen to the place where they had left their comrade, he was found to be dead. Autopsy showed that he was in good physical condition; the verdict after a careful enquiry was that he died from the 110-volt shock, alternating, and the authorities state that in their opinion it must be taken that the lowest pressure for alternating currents that can be considered safe should be considerably reduced from previous ideas.

THE PROBABLE CAUSE IN THIS CASE.

There are two possible causes in this case. One is that there was a partial connection between the primary and secondary service, and that the man who was killed got the benefit of a portion at least of the primary voltage. The other cause is evidently the time-factor, which has been shown to have such an important effect in these cases. In the writer's opinion, it is perfectly possible to kill by a pressure of only 110 volts, continuous current, if you take sufficient time. If the Chinese ever want some new kind of excruciating torture the recommendation might be made to them to try tying a man to a 100-volt service, making good connection, and leaving him there till he hands in his checks. It would be a brutal method, but probably not more so than some of their existing methods. Any one who has tried the experiment of taking hold of terminals in connection with a 100-volt service will know that at first, and for some little time, nothing is felt, then gradually a sense of heat develops, which increases and, if hold is continued, pain commences, and gets sharper and sharper.

In the present instance it is not stated how long the victim had been in connection with the service when the other workmen saw him lying on the floor. It would take them some little time to go a quarter of a mile on mine roads which are very heavy for walking, and it was stated that the order to turn off the light was not understood, as the lamp was still burning when the men returned to it. So that it is probable that the victim was in connection with the service for something like half an hour. It must be remembered that with alternate currents the pressure which operates upon the human body to give shocks is the top pressure of the alternation. That is to say, with a 110-volt service the acting pressure on each side of the alternation would be 110×1.41 volts, or 155 volts. In addition to this, since the alternations follow each other at intervals of a small fraction of a second, the double maximum pressure will be felt in the shock. The nerve will be subject first, to the maximum pressure in one direction, and immediately after to the maximum pressure in the opposite direction. So that shock would be due to 310 volts in this case, plus any induction that might arise. And this is not all. The above refers to shock alone. But after the shock had contracted the muscles and prevented the victim from losing his hold, a current would pour through the body, and this current will be that due to 110 volts, but being an alternate current it will not be subject to such a high induced back pressure within the body itself, as a continuous current would from the motion of the fluids in the blood vessels in opposite directions.

SOME NOTES ON ALTERNATOR DESIGN.*

BY JOHN DENHAM.

(Concluded from page 514.)

Motors of small power, say, one horse-power to three horse-power, are usually speeded at 2,000 to 1,500 revolutions per minute; now what mechanical machines are there in the market taking one horse-power and requiring a speed of 2,000 per minute? Very few, indeed, I think. Such a motor would probably be called upon to drive a lathe or drill at sixty revolutions per minute, and it would be necessary to gear down from 2,000 to 60 revolutions, and then what proportion of your original horse-power is left? Fancy adopting a five-horse-power motor, running at 1,200 revolutions, to work, say, a turntable at a speed of one revolution per minute.

Taking most machines to which the application of electric motors is desirable, the vast majority do not call for a speed of over 100 revolutions per minute, and many of them much less than this; but alternating-current motors, even in large sizes, run at 350 or 500 revolutions, and all need gearing down. A direct-current motor can be built for any speed without much trouble, but an alternator must run (at its full speed) at some fraction, minus the slip, of the impressed periodicity; therefore the only practical way of keeping the speed of the motor low is to reduce the periodicity. For this reason if motors only are to be used in the circuit—this is assuming a most exceptional case—twelve to fifteen cycles may be used.

If some lighting is likely to be called for, twenty-five cycles has been found satisfactory, as this is about the lowest at which incandescent lamps will run without appreciable flickering. I have seen thousands of eight-candle-power 110-volt lamps working very satisfactorily off such a circuit. I am not sure that pulsation would not be visible if five-candle-power 220-volt lamps had been used. It is certain, however, that at thirty periods, the critical point at which the persistence of vision comes in, the light from an incandescent lamp would be perfectly steady, however thin the filament might be. Therefore, if you are likely to require rotaries, induction or other motors and incandescent lighting at 110 volts off your mains, you are safe in using twenty-five periods. If you require higher voltage lamps, it is preferable to go as high as thirty periods, but beyond this it is not desirable to go, unless the lighting is by far the greater portion of the total load, motors being negligible. But even if lighting is at present the mainstay, one must always be prepared to tackle the motor question when it arises.

No doubt arc lighting would be very unsatisfactory at a periodicity of less than fifty cycles, but very few people are in favor of alternating-current arcs, either in groups at low pressure, or in long series direct off the high-tension main. The General Electric Company, of America, has introduced a constant-current transformer for this latter purpose which works satisfactorily, but the light from an alternate-current arc, even with reflectors, can not be compared in effective luminosity with that of an open direct-current arc. If arc lamps are required in any number, it would be best to use motor-generators separately controlled, and use direct current either of high tension for long series working, or of medium pressure for four to eight in series.

The substitution of modern polyphase plant for the original single-phase with which many English generating stations are fitted is a formidable undertaking, as it means that to obtain the best result almost all the original plant must be thrown out. No doubt this is the chief reason why one sees so many obsolete alternators at work, and why they are still being constructed by leading English manufacturers. To change over from a single-phase 100-cycle to a three-phase 25-30 plant, let us briefly see the alterations that would be necessary.

The original generators could not be utilized without rewinding, and even then their original output would be reduced to such an extent that they would occupy more space than they were worth, especially as the engines driving them would also be working at a most uneconomical speed. It is better, therefore, to get rid of the old plant altogether. Then as regards the mains, if they are concentric, they can be utilized by using one cable per leg, which is equivalent to having a star distribution with three earthed neutrals. This, from an economical point of view, is also absurd, as it neutralizes all benefits to be derived from the use of a three phase circuit. Also, if the capacity of the different branches do not balance trouble would ensue. It is true that where lighting and motors are employed simultaneously, it is sometimes considered advisable to use a fourth wire from the centre of the star and use only outer and neutral for each lamp circuit. This has the advantage of better regulation of the lighting circuits when they are unbalanced, and allows the use between the outers of 1.73 times the actual voltage supplied to the lamp. The latter, however, is more or less an imaginary benefit, as one can always save copper by raising the voltage of the lines, and also transform down as low as required before reaching the lamp. Few people attempt to save copper in interior wiring of buildings, whether the voltage is 110 or 220.

A special cable for three-phase working has been introduced in which there are three main conductors and three smaller ones, the latter acting as a combined neutral. The lamp circuits are tapped into one of the mains and any one of the three neutrals. Such a cable, however, would be complicated in the jointing, and it is doubtful whether the fourth wire is worth the extra trouble involved. As a rule, with fair balance on the three legs of an ordinary three-phase system, the lights are found in practice to be sufficiently uniform, especially when three-phase transformers are used as against grouped single-phase. To return to the question of utilizing a high periodicity single-phase plant, we have seen that the generators are useless, and that the concentric cables that are assumed to exist could be utilized, but it would be far better to discard them for three or four core cables. The other important part of the plant to be considered is the transformers, and the question arises can transformers built for, say, 100 cycles be used on a twenty-five or thirty-period circuit? I have not been able to try the actual experiment, as although I can, of course, run my machines at any periodicity desired, I can not simultaneously obtain the full voltage. I anticipate, however, that the ratio of transformation on open circuits would remain the same; but owing to the quantity of iron being insufficient to take up the increased magnetic flux, the voltage would drop off as the load came on, very much the same as if the transformers had a high internal resistance. It might be feasible to run two transformers in series, giving, of course, only half their original output, but this at best would be a miserable makeshift, and would sacrifice the valuable balancing properties of polyphase transformers. It appears, therefore, that if one has a high periodicity single-phase plant, and wishes to change over to a low periodicity three-phase system, the original alternators, the concentric cables, and the transformers must one and all be discarded.

Those who provide the funds, whether a company or a government, naturally wish to assure themselves, before taking such a drastic step as to throw out the whole of a plant, that the system about to be adopted will not, in its turn, become obsolete in a few years to come. This guarantee one would be very loth to give, but the polyphase system seems to possess such flexibility that it leaves little to be desired. Advances in generators, motors, etc., are to be anticipated, not as regards efficiency, but output for weight and price and increased power-factor.

*Paper read before the Cape Town local section of the Institution of Electrical Engineers, April 28.

Wireless Telegraphy by the De Forest System.

By A. Frederick Collins.

THE development of wireless telegraphy, ever since its commercial conception in 1897, has been very largely due to foreign invention and improvement, and until very recently the English alien, English and German workers were taking the lead, while France, Belgium, Russia and even Spain have found those who applied themselves to its solution.

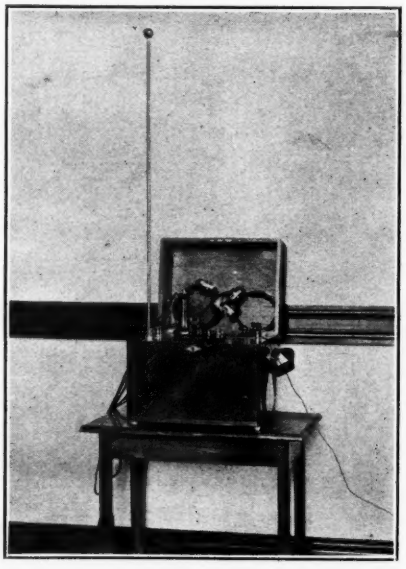
Until the past year little was heard of any serious work in this direction in the United States, but almost simultaneously two American systems have been placed upon the market, and if the tests in the recent naval manœuvres count for anything, one of these was so far in the advance of the only foreign system represented that its name should lead all the rest.

The wireless telegraph system which achieved this signal success is the invention principally of Dr. Lee De Forest, a graduate of Yale University; Mr. Edwin H. Smyth, an electrical engineer of Chicago, and Professor Clarence E. Freeman, of the Armour Institute of Technology, of Chicago. The first two gentlemen evolved the receiving apparatus, and to the latter is due the transmitting device; both of these instruments differ in many respects from the stereotyped induction coil and coherer appliances, and this, together with the fact that the inventors are Americans and the apparatus of domestic manufacture, makes its advent one of importance.

To those advanced in the art it is well known that with induction coil generators considerable trouble is involved with the working of that portion of the apparatus for breaking the current, whether it is of the mechanical vibrating, the mercurial rotary turbine or the electrolytic type of interrupter, and these difficulties lead to the arrangement employed in the present transmitter of the De Forest system.

The complete transmitter is shown, and is in this case operated with a 110-volt, 60-cycle alternating current from the Edison mains. The current is then stepped up by means of a rotary transformer 1, to 500 volts; in series with this circuit is the key 2 and the primary of an ordinary commercial oil transformer 3; the telegraph key 2 has the appearance of a steel lever leg key, but is provided with means for breaking the current under oil, and the speed with which heavy currents may be segregated into dots and dashes may be as easily maintained as when operating over a wire circuit. In this key the portions carrying the high-potential currents are insulated from the metal portions of the key proper, and the danger attending the breaking of high-tension currents is eliminated.

In the oil transformer 3, the current of 500 volts is stepped up to a potential of 25,000 or 50,000 volts as desired, and this high-potential, low-frequency current is lead direct to the spark-gap 4 which is in



The Receiver Used with the De Forest System of Wireless Telegraphy.

series with the condenser 5, consisting of a battery of Leyden jars. The spark-gap is formed between three metal discs, the two outer ones being adjustable and the centre one stationary; these are mounted on corrugated pillars to ensure the highest insulation. When the Leyden jars are changed to their maximum capacity they discharge across the air-gap between the oscillator discs, breaking down the insulating film of air and filling the entire area of the space between them with a heavy discharge, and this in turn sets up oscillatory currents in the terminal wire 6 leading from the spark-gap to the earth on one side and to the antenna 7 on the opposite side.

A sheet of metal 8 is interposed between the key 2, the oscillator 4, 5, as shown, and the rotary transformer, as an electrostatic screen, and the untoward effects of breaking the current on the transformer, resulting sometimes in burning out the coils, is prevented by two intervening inductance coils 9, which act as choking coils and dissipating the high-frequency currents before they reach the armature. In places where an alternating current is not available, an engine-driven generator is employed; in this case a gas engine driving an alternator is used; the latter is coupled to a rotary transformer.

The effort of Mr. De Forest to produce a receiver more sensitive, more rapid and more accurate than the cumbersome and expensive Morse recorder seems to have met with a very large degree of success. The receiver of De Forest consists essentially of a "responder," a single cell for energizing the circuit and a pair of telephone head receivers. It is also shown complete, and does not appear unlike an ordinary portable testing set, the whole apparatus being contained in a box of similar size.

The antenna and ground are connected through the primary of a small transformer coil, and the terminals of the secondary are in series with the responder, cell and telephones. Some resistance coils are included in the circuit so that it is possible to increase or decrease the current flowing through the responder circuit as may be necessary. The object of the transformer coil is to dissipate the charges of positive and negative electricity which accumulate at the terminals of the earthed wire and the antenna, and these equalizing in the system cause the detector to register and very often confuse the operator.

While the responder is similar to the coherer in mechanical construction it differs from the latter in that its particles of metal, which are held in a state of suspension by means of a viscous solution, do not cohere under the influence of electric waves, and again it is different from an anti-coherer in that its action is electrolytic. It resembles the latter in that its normal resistance is raised by the difference of potential created by the impinging electric waves. Like the anti-coherer and the auto-coherer it is self-restoring, that is to say, the instant the potential difference between its segregated

particles is equalized it returns to its normal state of conductivity, for in the responder the current is always flowing through it except when the oscillations act upon it.

So far as its action is concerned, it is as instantaneous as that of light, and the impulses representing Morse dots and dashes may be received as rapidly as the ability of the operator will permit and with whatever speed it is possible to actuate the transmitter. With this receiver a normal speed of twenty-five words per minute may be maintained and a speed of thirty or forty words a minute may be obtained.

When an induction coil with electrolytic or mercury turbine interrupter is employed at the transmitter station instead of the regulation De Forest apparatus the received impulses correspond closely to the number of interruptions of the primary current and a musical note is produced. Perchance in this very feature lies a simple solution of syntonic wireless telegraphy. And, indeed, very recently two messages were received and deciphered simultaneously by two De Forest operators at their New York city station, No. 17 State street; one of the messages was transmitted by the De Forest Staten Island installation and the other by a Marconi equipment, probably on some vessel.

The distance over which messages may be received by an apparatus employing self-restoring detectors is much greater than when a relay and coherer are employed, assuming an equal amount of energy is expended in converting the oscillations into waves. As an illustration of the exceeding sensitiveness of the responder, when the Deutschland, of the Hamburg-American Line, was on her outward trip last July, the messages flashed from her antenna when out a distance of seventy miles were received by the De Forest operators; the Deutschland carried an installation of the Slaby-Arco system.

Prior to that test, in February, signals were received at the Jersey City station sent out by the Etruria equipped with the Marconi system when the vessel was ninety miles at sea.

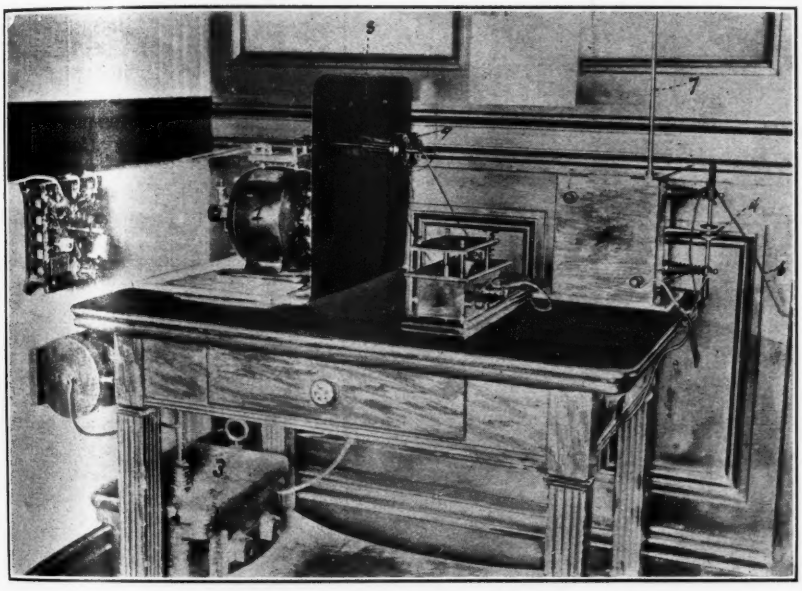
The De Forest Coney Island station, here described, was put into service for the first time June 14, and communication established with the Morro Castle, of the Ward Line, having on board a De Forest equipment, and messages were transmitted and received by both the shore station and the vessel's apparatus until a distance of fifty miles separated them.

The station is located at Steeple Chase Park, Coney Island. Its mast is 210 feet in height and is constructed of four poles set in cross-trees and fids, *i. e.*, a square bar of iron with shoulder at one end to support the topmast over the head of the lower mast; the mast is guyed to braces sunk into the sand 16 feet. The guys are of wire-rope and hemp-rope terminals spliced in about 100 feet from the ground, these being to maintain the insulation should the antenna or any portion of the cables forming it come in contact with the guy. The antenna consists of two cables supported by a yard-arm near the top.

During the recent naval manœuvres, apparatus of the De Forest construction was installed at Fort Marshal, and another set was placed on the scout-boat Unique. The maximum distance between the shore and the boat was fifty miles; there were seventy-two messages transmitted between the installations and ninety-five per cent were received clearly.

The objections to wireless telegraphy in war manœuvres have been pointed out by Captain Sigsbee to be numerous, and among them is that it is "costly, complex and delicate and uncertain in transmission." In June, 1901, I advanced a similar argument, and stated that before wireless telegraphy could become commercially popular there were four things to be done for it: (1) To effect syntonization by simple means; (2) to lessen the first cost of the apparatus; (3) to do away with the masts, and (4) to increase the speed of transmission.

One of the greatest points in favor of Mr. De Forest's invention is its simplicity, and all its other inherent qualities may be directly attributed to this most excellent feature.



THE TRANSMITTER USED IN DE FOREST SYSTEM OF WIRELESS TELEGRAPHY.

Testing of a High-Tension Switch.

Some interesting tests of a high-tension switch were recently made at the Colgate power-house of the Bay Counties' Power Company, in Yuba County, Cal. A single-pole switch was connected directly across the 40,000-volt bus-bars that were receiving current from the generators having a rated capacity of 7,500 kilowatts through transformers of equal capacity. This switch was closed and opened ten times in the space of two minutes, and it opened the dead short-circuit each time safely and easily and without damage to the switch, transformers or lines.

One of the two Bay lines that were in parallel was then cut out at Colgate, but left in parallel with the other at a station 120 miles from Colgate, and the switch connected across this line, thus giving 240 miles of line between the switch and bus-bars. The switch was closed and opened fifteen times in the space of three minutes, and it opened the short-circuit each time safely and easily and absolutely without damage to the transformers or lines. The switch opened the short-circuit the twenty-fifth time fully as well as the first time, and was not at all damaged by the extremely severe test of opening a dead short-circuit at 40,000 volts, with generator and transformer capacity of 10,000 horse-power behind it, twenty-five times.

Electrical Apparatus in English Coal Mines.

The coal mines of England, the primary source and the essential element of her industrial supremacy, have now been worked extensively for more than a century. Until a few years ago England mined more coal than any other country in the world. However, this is no longer the case. American production exceeds the English, which is now almost stationary from year to year, by rapidly increasing percentage. This is beginning to be felt even now. The price of coal in England is steadily rising, shafts are being carried deeper and deeper and, the richer veins having been exhausted, the thinner veins, containing often poorer grades of coal, must now be developed. These things have put the British operator upon his mettle, and he has taken up the latest and most improved methods of coal mining even more rapidly than his American competitor. Moreover, he has stepped out boldly and adopted for power transmission alternating currents and induction motors, which, for mining work and especially coal mining, have many great advantages over direct-current machinery. The foregoing facts are well illustrated in the following brief description of the electrical plants recently installed at a number of English coal mines.

The Sneyd colliery, at Burslem, Staffordshire, has recently put in a complete alternating-current equipment. Current is generated by a three-phase alternator, direct coupled to a steam engine. Induction motors, aggregating about 1,000 horse-power, are used for driving "main-and-tail" and "endless" rope-hauling engines for pumps and for several other auxiliary purposes. The hauling gears, with their electric motor equipment, are shown in the accompanying photographs. These mines are gaseous, and the use in them of direct-current machinery would have been dangerous. The induction motor, however, on account of the fact that it has no moving contacts to spark or flash is well adapted for use in such locations.

The Clapwell colliery, of Chesterfield, has recently installed two 3-phase alternators, one of 225 kilowatts capacity and the other of 20 kilowatts, together with a 6-kilowatt, direct-current exciter. The British Westinghouse company also furnished ten induction motors, aggregating 280 horse-power.

The Oxcroft colliery, of Chesterfield, has installed two 3-phase alternators, each of 200 kilowatts capacity and operating at 440 volts, 30 cycles per second and 100 revolutions per minute. The equipment includes two exciters, each of 11¼ kilowatts capacity, and a small generator of 1½ kilowatts capacity; also thirteen induction motors with an aggregate capacity of 300 horse-power and a complete switchboard outfit for the entire plant.

About 4,000 horse-power of electrical apparatus is about to be installed in the several collieries owned by the Stavely Coal and Iron Company, of Chesterfield.

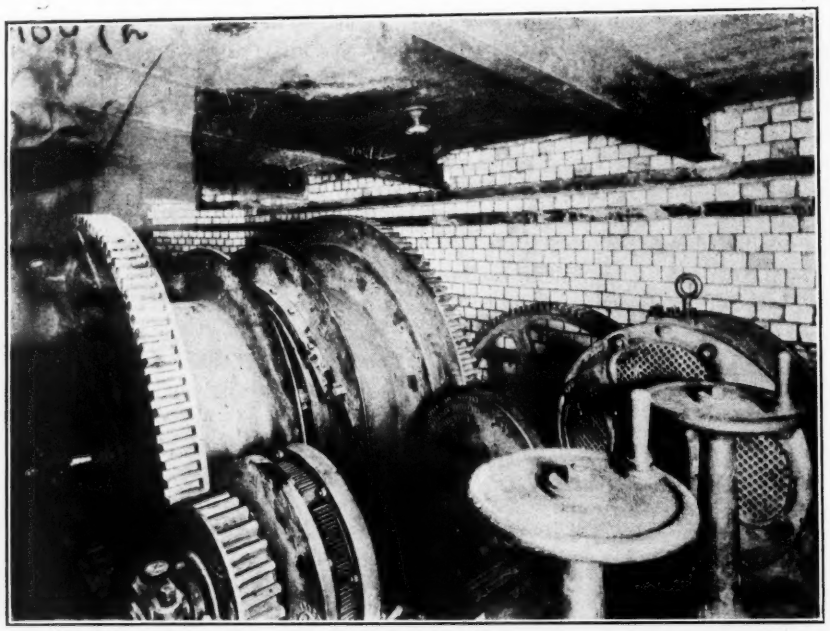
The Sherwood colliery, of Mansfield, has purchased two 3-phase alternators, each of 50 kilowatts capacity and operated at 440 volts, 60 cycles per second and 900 revolutions per minute; also three direct-current multipolar generators of about 12 kilowatts aggregate capacity.

At the Tredegar Iron and Coal Company's collieries, in Monmouth, a complete power equipment is being installed, comprising two 150-kilowatt, 3-phase alternators, two exciters, each of 7½ kilowatts capacity, and ten induction motors ranging in size from 50 to 5 horse-power, and aggregating 220 horse-power.

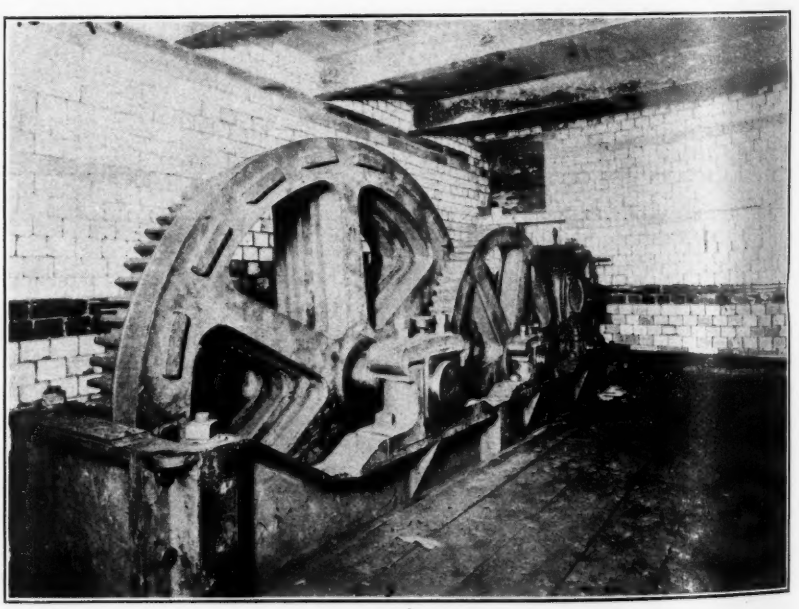
The Bolsover Colliery Company, of Chesterfield, has decided to adopt electric driving to a considerable extent, and has placed a large order with the British Westinghouse company, including a 180-kilowatt, 3-phase alternator, together with exciter, a 200-horse-power induction motor, complete switchboards, etc.

The Stanton Iron Works Company, of Pleasley, will equip its collieries with electrical apparatus, including about 150 kilowatts in generating capacity and 100 horse-power in motors, all purchased from the British Westinghouse company.

The apparatus mentioned above is all of Westinghouse design, and is typical of many other installations made with this type of electrical machinery.



INDUCTION MOTOR OPERATING "MAIN AND TAIL HAULAGE" AT THE SNEYD COLLIERY, BURSLEM, STAFFORDSHIRE, ENGLAND.



INDUCTION MOTOR OPERATING "ENDLESS HAULAGE" AT THE SNEYD COLLIERY, BURSLEM, STAFFORDSHIRE, ENGLAND.

Machine Tool Progress—I.

By Charles E. Hadley.

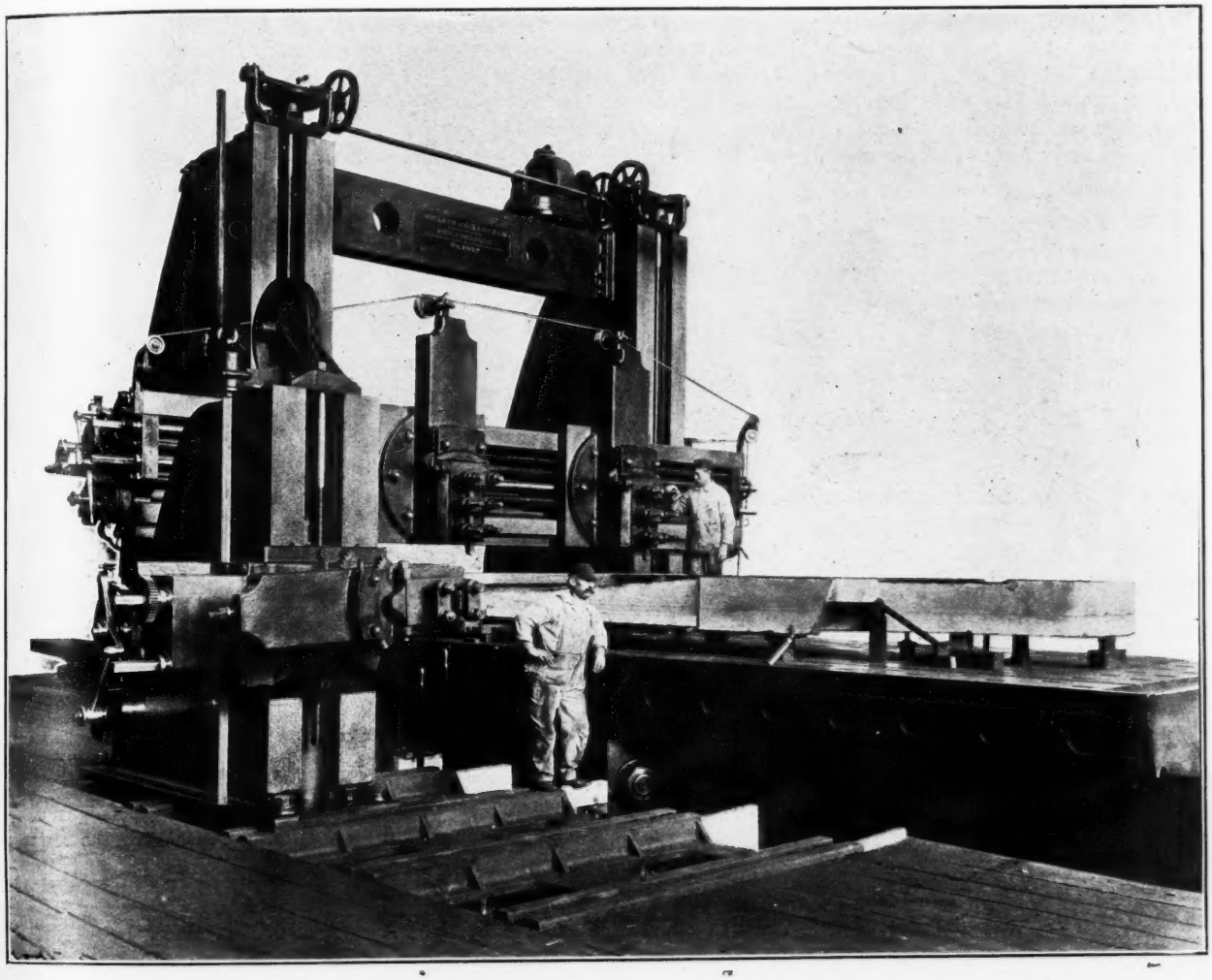
WE VIEW with astonishment the persistent regularity of the pace in scientific development, and that part of it which includes mechanical and electrical invention has been particularly striking.

The rapidity with which a nebulous inspiration evolves into a commercial product at the present time would be much more impressive than it is were it possible in the increasing rush of events to get a reasonably slow-moving standard for comparison. The American system of invention, development and manufacture, while composed of many independent working elements, is a great force for speedy progress, and not the least important unit of the aggregation is the machine tool industry.

This entirely unspectacular member of the industrial family is very close to the foundation of the monumental structure we admire. It makes possible the prompt realization of the inventor's practical dreams, as assets of large ventures it is always visible; it solves the problem of economy and makes the 100-ton gun and the one dollar watch a practical product. The ordinary observer is likely to save his admiration and awe for the product, but the tool builder, as he cramps his neck to see the top of a thirty-foot armature, thinks of the boring mill and the handy portable appliances that made it a practical possibility to turn out such monsters at anything less than a prohibitive cost.

Inspired by the love of his art and incidentally, of course, by the hope of the material benefits to accrue therefrom, the maker of tools has always responded to the spur of an active competition, and the demands of a tremendously varied manufacturing interest by always being ready to meet new requirements as they appeared. And the modifications and improvements in tools in the last twenty years have, while less commented upon by outsiders, been quite as important and successful as those noticed in the great developments they have been called upon to aid. The ingenuity and patience of a high class of mechanical minds have in the period above mentioned accomplished much in eliminating expenses of manufacture, in making difficult operations easy and in bringing formerly impossible ones within the scope of practicability.

Let us roughly review the history of standard lines of tools to show how these things have been accomplished.



A Very Large Modern Planer Built for the Midvale Steel Company, by William Sellers & Company, Inc., Philadelphia, Pa.

Everything, as a matter of course, tends to the automatic handling of work so far as the quantity of what is to be produced will warrant it. Consequently all the old standard types of machine tools are the ancestors of long lines of variations in which, in many cases, the vital principle is the only feature we recognize.

The lathe, as the chief essential, has naturally been the basis of a greater variety of specializing than the other forms of tools, as it was the first to drop its O. G. cornices and other architectural frills in bed design, which elimination occurred, however, prior to the period under consideration, but the steps in improvement, subsequent to that important change, form an interesting series.

As to the main features of the engine lathe, pure and simple, the tool has held its own. There have been remarkably few changes in principle. Like most old institutions it is established. But while it has the same members it has been vastly changed in its proportions, the steps in its evolution have not occurred always in logical sequence. Although in the main the redesign of the machine, with a view to removing the greatest amount of stock in the shortest time, preceded the development of the other factor in economy, namely, design for convenience of handling the work, which called into being the variations upon the lathe hereinafter to be considered, the tool had not acquired its present satisfactory proportions before considerable had been done in specializing it.

We will always have the engine lathe, grown heavy, however, in its maturity, with which the finished dimensions of its product are no longer a compromise between the spring of the machine and the yield of the cutting tool. The lathe of twenty-five years ago does pretty well for turning wood in the pattern shop, though most of its contemporaries have found their way to the junk-dealer.

The competition between the lathe and the cutting tools has shown that interesting see-saw effect noticeable in the relations of the cracksman to the safe, and the projectile to the armor plate with quite as beneficial results.

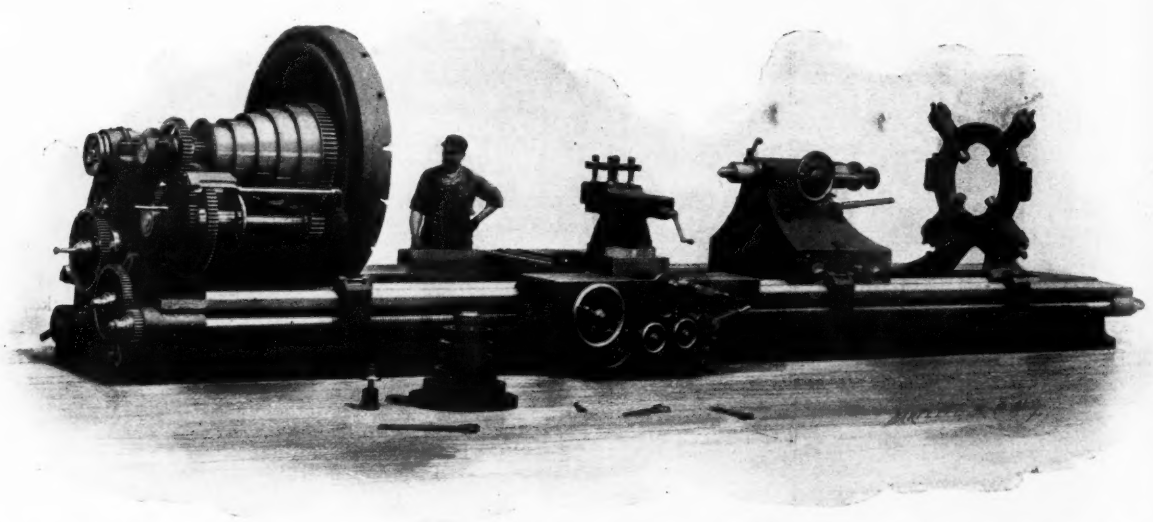
The delicate diamond point of long ago did not oppress the frail structure which carried it, it simply vibrated harmoniously, and the feed was kept fine to make it easy for it until the aggressive spirits became impatient and used heavier tools and increased the feed, when the weakness of the machine became apparent. It took some resolution to break away from the time honored proportions; it was argued that heavier spindles, longer heads and carriages would make the machine clumsy; but it came about, heads were lengthened, spindle diameters were increased, carriages were lengthened in their bearings on the ways as well as on tool post slides, and the beds were also deepened.

My recollection is that the David Pond Company was among the first to come out with a heavy pattern. The Niles combination is now building the tool and an illustration will be found in these columns which will illustrate one of the many good makes of heavy tools of this character.

But even with the increased rigidity the desire for economy was not appeased. With the coarser feeds, encouraged by the ability of the machine to stand the stress, the work proved too much for the strength and edge of the cutting tool, and then self-hardening Tungsten steels were generally adopted where scientific attention was paid to economy. Now we find in the up-to-date shop machines and cutting tools of such proportions and material that the only limit to the amount of stock removed in a minute is the torsional elastic limit of the piece of work operated upon. Amply back-geared the belt does not slip, designed for rigidity the machine does not yield from the cutting tool of a steel which holds it temper and which does not break, the chips fall dark blue and smoking of the maximum thickness for each diameter.

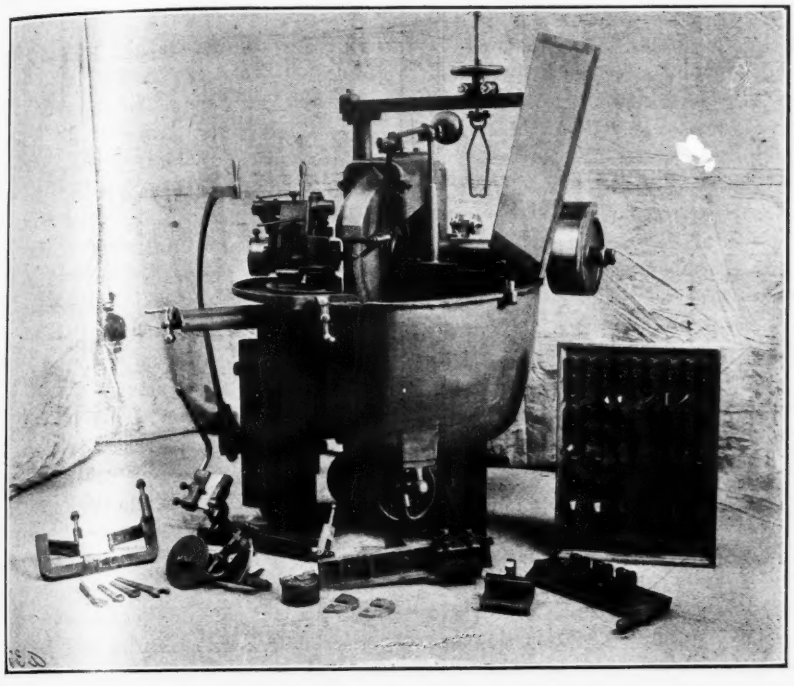
So much for brute force, but there are other elements in the combination. Along with the study to give the balance of power to the cutting combination, attention was given to shape the cutter so that it should not overdo its work and expend valuable power in torturing and bending the chip after it had removed it and had legitimately finished its work.

A razor would be the proper tool for turning if the sections of the tool were only heavy enough to back up the edge. The machinist is not turning a furrow, nor is the lathe supposed to furnish power to grind up its chips in a form suitable for fireworks. So the tool edge is the compromise of good experience, and to avoid the ills of inexperience, where good, bad and indifferent workmen are using lathe tools, uniformity is of importance when standards have been established. I venture to say a trip through many a machine shop would discover



MODERN SEVENTY-TWO-INCH LATHE BUILT BY THE NILES TOOL WORKS COMPANY. THIS LATHE IS DRIVEN BY THE FACE-PLATE GEAR ONLY. THE CONE MOVES ON A SEPARATE STEEL SHAFT.

turning tools ground to all the points of the compass, in fact to the individual taste of the workman, where the matter is no more one of taste than are the rules of arithmetic.



A Machine Tool-Holder as now Manufactured by William Sellers & Company, Inc., Philadelphia, Pa.

Tool-holders with fixed sections have done much to standardize things in this line, and tool-grinders have done more, because they take care of all the angles.

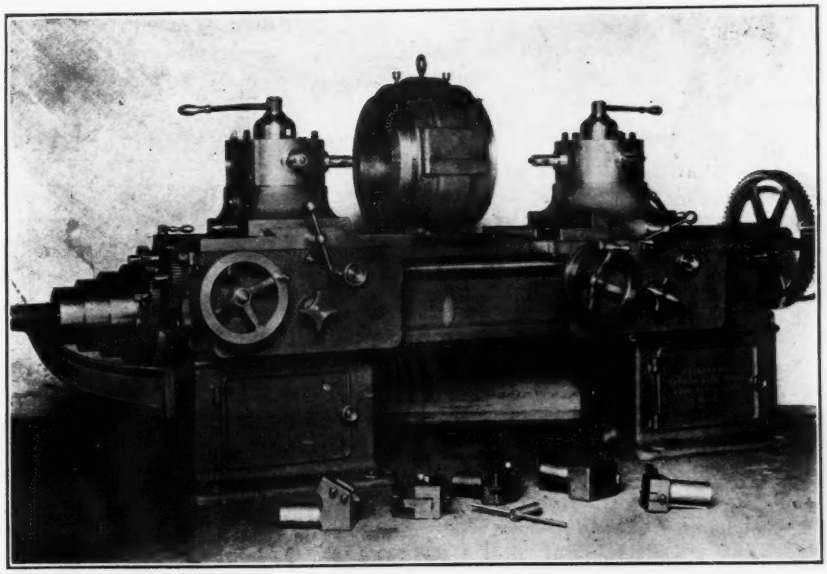
A very interesting and useful machine tool of this description is made by William Sellers & Company, of Philadelphia, by reference to the illustration; it will be seen how the adjustments of the holder adapt it to the various forms and angles of different classes of turning tools, and how much more sensible it is for a boy or a man, for that matter, to grind the tools for the whole shop than to depend upon the much slower, less sure, method, of every one for himself, on a wheel or, worse, an uneven and camlike grindstone. The time I spent coaxing V-thread tools into shape I charge in part to the undeveloped past.

When the element of economical removal of stock with a single tool has been seemingly brought to perfection we have the question of distribution of cutting work and that of convenience in handling. These problems inspired the turret lathe and screw machine.

The old shafting lathe, as the progenitor of the screw machine with its two or three tools carried either side of a ring in the form of a follow rest, gets into evidence early enough to disarrange our chronological sequence, but it did not have the turret or wire feed.

It was arranged, however, to divide the cutting stress in having cutting tools diametrically opposed to decrease lateral stress, making it as nearly perfect torsion as possible, and in the class of work to which it was applied the roughing and finishing cuts were taken simultaneously and the curves and twists were subsequently taken out with a screw press and a peaning hammer. In the matter of distribution of cut the object of the tool-builder is to attack the work simultaneously at as many points as possible and many ingenious devices, some new and some old, are in evidence. The axle lathe built by the Niles Tool Works, with a driving chuck in the centre of the bed with a carriage at either end, is the older form, which machine was amplified into a double turret machine by E. P. Bullard, now the Bullard Machine Tool Company, of Bridgeport, in which machine the carriages were each provided with a turret with power feed, making an admirable arrangement for operating on both ends of a piece of work at the same time with one setting, ensuring alignment and saving time. In the modern vertical boring mill the principle of simultaneous operation is well illustrated. In the large sizes as many as four tool-posts are provided, and a piece of work like a gear or flywheel may have its rim turned and faced and its hub bored and faced at one time.

In the smaller sizes the Bullard Machine Tool Company has not only provided its mill with a turret, but also with a live spindle in addition to the stationary tool block, so that a piece like an engine crank may have the hole for the shaft bored and the hub faced and then have the crank-pin hole drilled by stopping the table rotation and driving the live spindle which is set at the proper radial distance. This completes the job in one setting. Of turret and screw machines there is an endless variety in which every element of economy for duplication of parts is considered.



Turret Lathe Made by the Bullard Machine Tool Company, Bridgeport, Ct.

The Franklin Institute Meeting.

At the section meeting of the Franklin Institute, Thursday, September 25, the paper of the evening was by Mr. George F. Stradlung, on "The Ionization of Gases," an abstract of which follows:

It has been shown that by the passage of the electric spark through steam, as well as by the passage of current through alkali salt vapors, products appear which conform in quantity to Faraday's laws of electrolysis.

By a variety of processes a negative ion, which is not the same in mass as the negatively charged ion of liquid electrolysis, can be separated from the atom. The remainder having a positive charge differs according to its origin, while all negative ions seem to be alike in rarefied gases.

The chief agencies in the production of ions are:

1. Rays from radio-active substances—Becquerel rays.
2. Roentgen rays.
3. Ultra-violet light.
4. Cathode rays.
5. Certain chemical processes.
6. High temperature.
7. Electrostatic stress.
8. Impact of moving ions.
9. Spontaneous production.

These are not all independent. Both positive and negative ions, when the ratio of electric force to gas pressure is sufficiently low, become attached to groups of molecules.

Generally the negative ions move more rapidly than the positive ones. However in the case of ions produced by high temperature it seems that higher speed goes with the positive ion.

Among the things explicable by the theory of ions are:

Many of the phenomena of the discharge of electricity through gases.

The tending of the electric current through a gas toward a maximum as the electromotive force rises.

The discharge of hot conductors at a lower potential when charged negatively than when positively charged.

Possibly the weight changes accompanying chemical action observed by Sanford, Landolt and Heydweiller.

1. The occurrence of auroræ.
2. The luminescence of nebulæ.

Atmospheric air contains ions. By their presence is explained the discharge of electrified bodies which takes place independent of the leakage across the insulators.

While the rate of dissipation of the charge is greater for both positive and negative electricity on mountains than on the lowlands, it is far greater for negative, because the negative charge of the earth having a very high density upon the peaks attracts thither great quantities of positive ions.

The dissipation is much more rapid on clear than on dull, foggy days.

If a charged body be surrounded by a cage of wire similarly charged, the latter attracts ions, some of which pass within it and thus accelerate the discharge of the body inside. If the cage and body are oppositely charged, the discharge is made slower.

Ebert insulated a portion of the earth, let its charge be dissipated by the rain of ions constantly occurring and again connected it to the earth. Then a current flowed from the insulated part to the earth. It took in some cases only five minutes for the discharge by ions to be completed. This undoubtedly shows a very high rapidity of discharge for the earth.

The origin of the atmospheric ions is to be sought in the action of ultra-violet light in the upper regions of the atmosphere and in cathode rays developed there by negatively charged particle arriving from the sun.

Electrolysis and Waterworks.

At the recent convention of the Central States Waterworks Association, held in Indianapolis, Ind., an extempore talk was given by Mr. L. Clifford Anderson, of Franklin, Ohio, on electrolysis and its relation to the city waterworks, this being followed by more or less informal discussion.

"Electrolysis," said Mr. Anderson, "is the name given to the mechanical process which consists in the dissolution of chemical compound by the passage of an electric current through such compound. As applied to waterworks this takes place in the passage of the electric current from water pipe into the soil. The soil contains salts in solution. These salts vary in their character, but they nearly always contain sodium chloride from the street washings. There is a certain amount of refuse necessarily on the street at all times, necessitating the subsoil, being highly saturated with salts in solution, and the pipes are buried in the soil. These salts are decomposed by the passage of the current from the pipe into and through the soil, and the acid constituent of that process of decomposition attacks the iron, or the lead or the copper, as the case may be, of the pipe. The metal passes into solution, leaving in place of the metal, in the case of cast-iron pipe, a carbon in the form of graphite, which is not soluble in the ordinary acids or salts.

"This process is continuous, and does continue in proportion to the amount of current which leaves the pipe, until the pipe is so injured that the pressure of the water in the pipe causes it to burst. As you all know, in operating the the single-trolley system, the current passes from the car into the rails and is supposed to pass along the rails back to the power-house. Part of it does sometimes. But inasmuch as the rails are in direct contact with the earth part of that current which is passing along the rails must necessarily leave the rails and pass into the earth and into any underground metallic structures that may be buried in the earth. This current does no injury to the pipe where it enters, but it does injure the pipe where it leaves the pipe and passes into any other conductor. As the current passes along the pipe it is found that a part of it passes around the joints of the cast-iron mains, on account of the high resistance of the joints. In measuring the resistance of the joints we find a great variation; some joints have a comparatively low resistance, some very high. I measured the resistance of one joint in a six-inch pipe last week which had a resistance of 40,000 times the resistance of one foot of six-inch cast-iron water main. On account of this high resistance part of the current passing along the pipe shunts around the joint. Wherever the current in shunting around the joint leaves the pipe and passes into the rail it damages the pipe at that point, so that you have two kinds of damage, one of them in the positive district, or that part of the piping system from which the current is leaving and passing to the power-house, or the return feeders of the power-house, and another kind of damage due to the passing of the current around the joints. Of course the current passes over approximately all of the pipes in the piping system, not only the pipes under the rails, but the pipes frequently which are far distant from the rails. This damage to the joints of which I have spoken is not confined at all to the positive area, or to the part of the system where the current is leaving to return to the rails; it is found throughout the whole piping system, negative as well as positive area. It is generally greatest at or near the point where the pipes are changing from negative to positive."

THE DESIGNING OF TELEPHONE APPARATUS—VI.

BY W. A. TAYLOR.

The following are the dimensions of induction coil commonly used by the Bell companies in connection with the solid-back transmitter.

Diameter of core, 0.25 inch.

Length of core, 3.75 inches.

Length of winding space, 3 inches.

Dimensions of head, 1 square inch, 3/8 inch thick.

The core is composed of 150 No. 28 B. W. G. Norway iron, annealed and surface oxidized after straightening and cutting.

Thickness of core insulation, $\frac{1}{32}$ inch.

Primary, 400 turns, No. 26 S. S. C. copper wire, measuring 1.62 ohms.

Secondary, 1,800 turns, No. 28 single cotton-covered copper wire, 21.8 ohms.

The terminals of the secondary are reenforced, being two strands of the No. 28 wire. This coil is used with a normal current of from 0.25 ampere to 0.45 ampere and gives very good service. This coil is somewhat different from the coil of the same type previously used, as the resistance of the secondary is higher. This is due to the change from the silk-covered wire to cotton-covered. The cotton-covered wire occupies more space than silk-covered wire, and therefore the resistance is higher for the same number of turns.

For a low-current transmitter on local battery work the turns of the primary should be increased, and at the same time the resistance should be kept as low as possible. It is the change in the ampere-turns that is necessary. So we may say that the turns on the primary should vary inversely with the current to produce a constant result, the resistance remaining the same.

When used in connection with central energy systems the induction coil assumes an entirely different design as to the primary winding. The number of turns becomes greater and the resistance higher. In this case the current used is very much smaller, and consequently the turns are greater. The coil is usually placed in circuit in an entirely different manner than with the local battery systems. There is little or no gain in the loudness of the transmission in this case, but the quality is improved considerably. Another office which it performs is to place the receiver on a local circuit, preventing the line current from passing through and demagnetizing it. Fig. 10 shows a central energy instrument circuit which is in use extensively throughout the country. LL is the line over which the current is supplied; P and S represent the primary and secondary windings of the induction coil; B is the bells, R the receiver, T the transmitter and C is a two-microfarad condenser. The function of the condenser is to prevent the flow of any battery current, but to

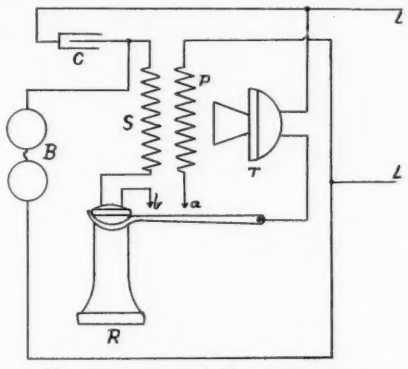


FIG. 10.—CENTRAL ENERGY CIRCUIT.

allow alternating current to flow. The current for talking comes into the instrument, passes through the transmitter, T, through the switch contact, *a*, primary, P, and out over the line again. A small portion also passes through the contact, *b*, receiver, R, secondary, S, bells, B, and thence out over the line. This latter quantity is very small, as it has to pass through a resistance of more than 1,000 ohms. The path of the secondary or induced current is through the line, condenser, *c*, secondary, *s*, receiver, R, contact, *b*, contact, *a*, primary, P, and over the line. Another path for the secondary circuit is through transmitter, T. There it is seen that there is a transmission due to the variation of the current supplied by the line, as well as a superposed secondary current upon it. In the transmission the secondary current plays but a small part, as it is nearly short-circuited by the transmitter. In receiving, the secondary circuit is very efficient. The condenser assists a great deal in the quality, as it seems to have the effect of making a clear, sharp tone which the circuit otherwise does not produce.

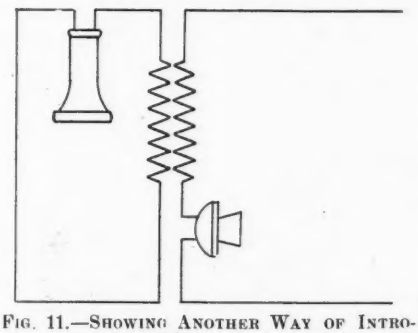


FIG. 11.—SHOWING ANOTHER WAY OF INTRODUCING THE INDUCTION COIL.

The primary of this induction coil has about 1,700 turns and measures about 17 ohms. The secondary has 1,400 turns and measures 28 ohms. The core is one-quarter of an inch in diameter and three inches long, composed of No. 26 Norway iron wire.

Another induction coil used for the same purpose and which gives very superior service has the following dimensions:

Diameter of core, ½ inch, No. 24 annealed Norwegian wire.

Length of core, 4 inches.

Length of winding space, 3½ inches.

Depth of winding space, $\frac{5}{16}$ inch.

Primary winding, 1,550 turns, No. 27 single cotton-covered wire, 15 ohms.

Secondary winding, 1,550 turns, No. 29 single cotton-covered wire, 30 ohms.

Another way of introducing the induction coil is as shown in Fig. 11. There is no advantage in this method except that it prevents the primary current from passing through the receiver. The same kind of induction coil as before described should be used with this circuit to produce the best results. There are some makers who use a regular local battery coil for this purpose. These makers are sacrificing the efficiency of their service by so doing. It is no doubt done, because there is apt to be a misunderstanding as to the kind of coils required when parties using both systems order supplies.

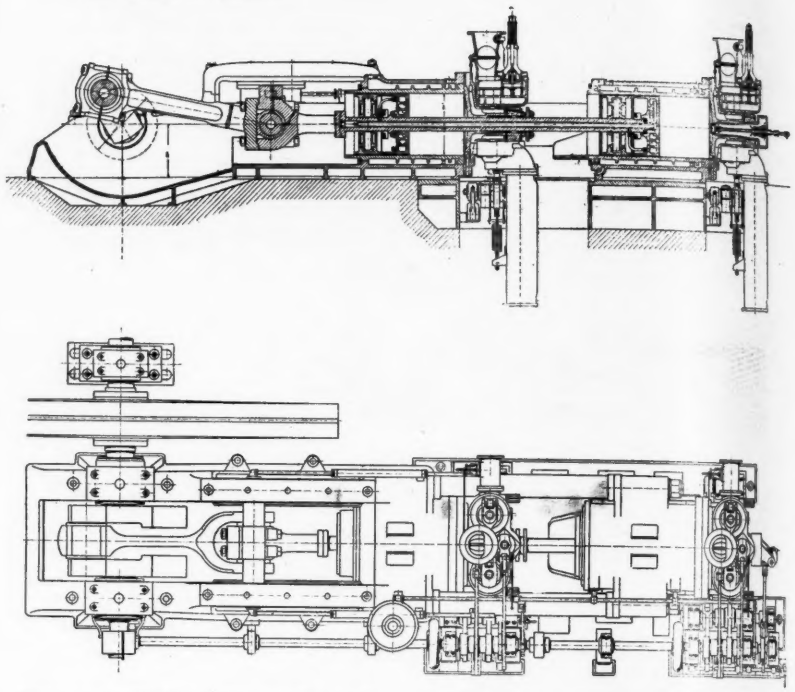
One point in the making of induction coils should always be remembered, and that is to make them durable. As one side is connected directly to the line it is very susceptible to burnouts from discharges of static electricity with which the line may be charged. Therefore, thoroughly insulate every part of the winding and use wire as large as can be used consistently. It is especially important to insulate the ends of the spool next to the core. Probably nine-tenths of the burning out of all kinds of coils used in telephone work comes from the poor insulating of the wire at the end of the spools next to the core. In fastening the paper used in insulating, a paste without acid should be used. The various white pastes used by photographers for mounting prints are excellent for this purpose. In case of a break in the wire the splice should be carefully soldered and a piece of paraffined paper should be folded over the joint, no acid or paste should be used as a soldering flux. A series solder has no chemical action and should therefore be used. In the local battery induction coils the primary should be wound in one piece. On account of the coarse wire used a joint would make a large lump and be apt to cut into the insulation of the layer above or below it and cut out part of the coil.

Electrical Stations Operated by Gas Engines, Supplied with Waste Blast Furnace Gases, in Germany.

By Frank C. Perkins.

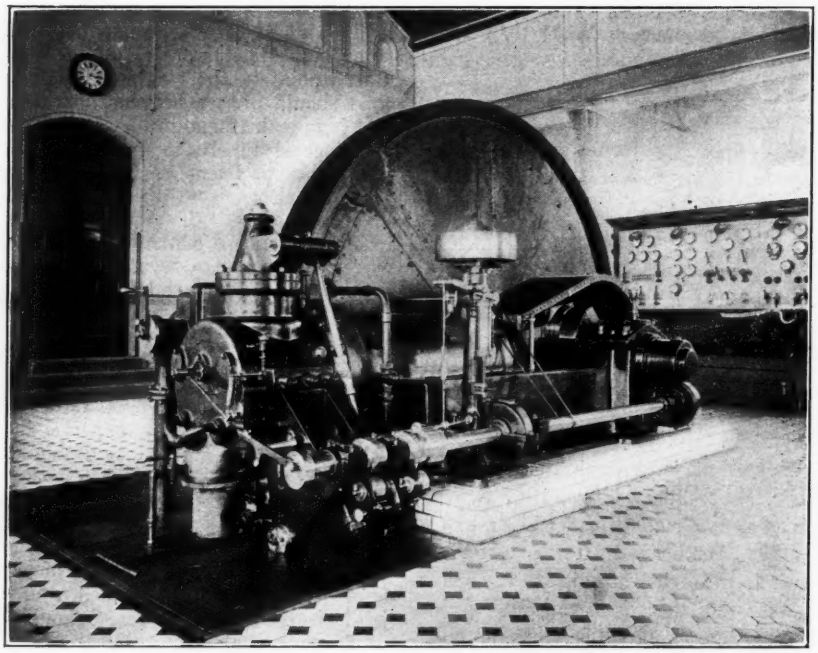
THE USE of gas engines for driving electrical generators in central power stations is becoming quite extensive both in this country and abroad.

In Germany, as well as in this country, many electrical plants are operated by gas engines, using waste blast furnace gases as well as illuminating, producer and natural gas. A 600-horse-power tandem gas engine using blast furnace gases is in operation at the power plant of Gebr. Röchting Hüttenwerk at Volklingen. This engine drives a Drehstrom alternating-current dynamo by direct-connection at a speed of 120 revolutions per minute. The current is generated at a pressure of 450 volts and is used for the electrical transmission of power. This engine, seen in the accompanying illustration, was constructed by the Vereinigten Maschinenfabrik Augsburg und Maschinenbaugesellschaft Nürnberg, A. G. of Nürnberg, Germany.



DETAILS OF 600-HORSE-POWER BLAST FURNACE GAS ENGINE, DRIVING DIRECT-CURRENT SCHUCKERT DYNAMO.

Among other important installations using gas engines built at these works is that of the City Electrical Station at Rostock. This plant consists of two gas engines of 125 horse-power each, driving direct-current multipolar generators, and the gas used by these machines amounts to 450 litres per horse-power-hour. The electrical generators are of 250 volts potential, and operate upon the three-wire system, electrical storage batteries being employed for accumulating electrical energy during light loads. A new 350-horse-power engine is to be installed in this plant in October of this year.



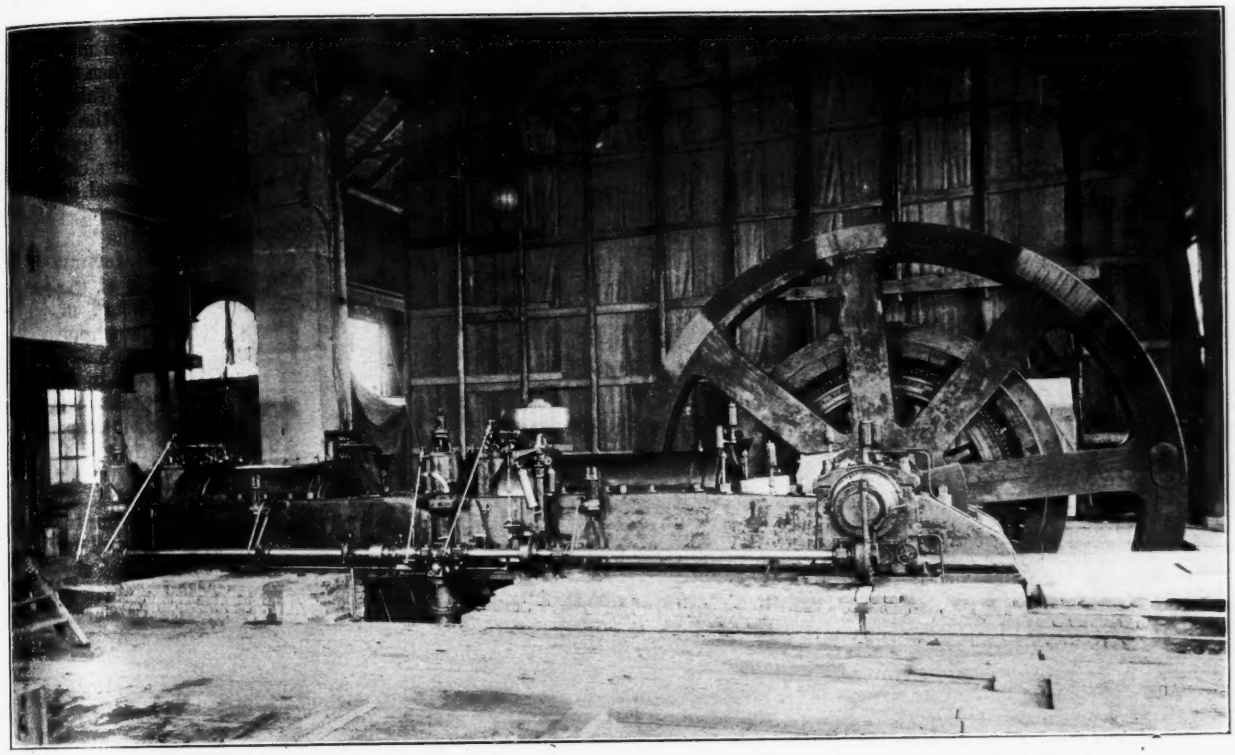
ROSTOCK SWITCHBOARD AND GENERATOR, OPERATED BY GAS ENGINE.

At the electric station of the Kuestrin depot the gas engine plant consists of two machines, driving multipolar direct-current machines for supplying current for arc lights. The machines generate a continuous current of 160 amperes at 220 volts, the speed being 190 revolutions per minute. The gas consumption amounts to from 400 to 420 litres per horse-power-hour.

The Vereinigten Maschinenfabrik Augsburg und Maschinenbaugesellschaft Nürnberg, A. G. have an interesting exhibit of gas engines and gas generators at the exposition at Nürnberg. The 100-horse-power engine, operated by blast furnace gases, has a speed of from 140 to 170 revolutions per minute, while the speed of the 750-horse-power engine is ninety revolutions per minute. This large engine drives a direct-current electrical generator constructed by the Elektricitäts Actien Gesellschaft, formerly Schuckert & Company, of Nürnberg, and supplies light and power for the Rheinische Stahlwerk, at Meiderick near Ruhrort. One of these large blast furnace gas engines was recently constructed by this firm with a capacity of 600 horse-power. This engine is of the tandem type and operates a three-phase dynamo at a speed of 120 revolutions per minute. It was constructed for electrical power transmission for the Hüttenwerk Karlshütte near Diedenhofen-Lothrigen. The cylin-

der of this engine is 900 millimetres in diameter and the stroke is 1,000 millimetres long, while the flywheel has a diameter of 6,400 millimetres.

At the Düsseldorf Exposition, the firm Louis Soest & Company, m. b. H. a mechanical efficiency of seventy-one per cent, the mean power indicated in the motor-cylinder being 544 horse-power, while the mean power indicated in the pumps was sixty-three horse-power or an effective indicated power of 481 horse-



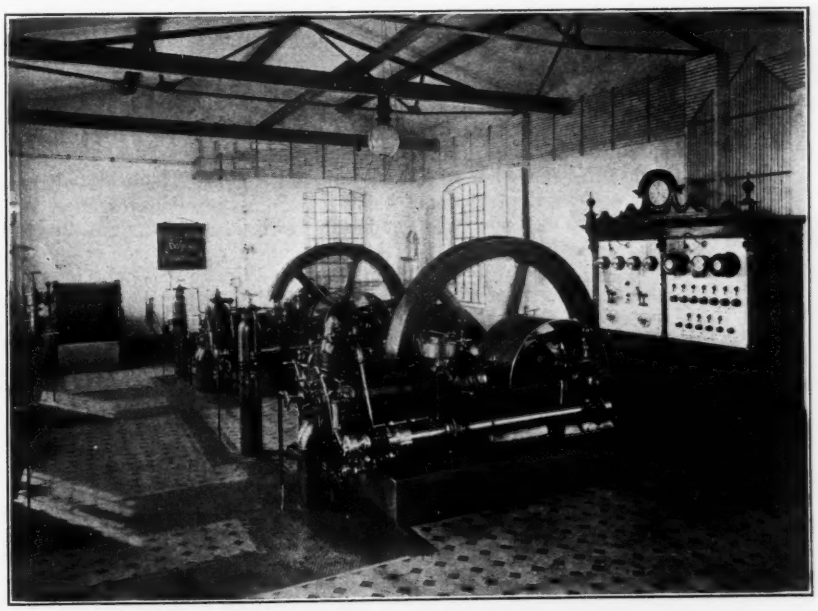
600-Horse-Power Tandem Blast Furnace Gas Engine, Driving 450-Volt, Polyphase Alternating-Current Generator.

Maschinenfabrik und Eisengiesserei, of Riesholz, near Dusseldorf, have three important exhibits of steam engines, pumps, compressors and various lines of general machinery, and a fine display of large gas engines, including one of 350 horse-power for operation with blast furnace gases, as shown in the accompanying drawing.

This engine is of the double-cylinder type with a flywheel weighing twenty-six tons between the two cylinders. The cylinders have a diameter of 650 millimetres each and the stroke of 850 millimetres and the normal speed is 140 revolutions per minute. The total weight of the engine is seventy-six tons, and is used for operating a three-phase alternating-current generator.

A double working 750-horse-power gas engine of the blast-furnace type is shown in the accompanying illustration. This was constructed by Gebr. Körting, of Körtingdorf, near Hanover. The cylinder is 750 millimetres in diameter and the stroke is 1,300 millimetres in length, while the speed of the engine is from 85 to 90 revolutions per minute. Five of these gas engines, of 1,000 horse-power for operating electrical generators, are being constructed for the new Lackawanna Steel Works now being built in Buffalo, N. Y., and owned by the Lackawanna Iron and Steel Company.

A Körting 350-horse-power engine of this kind was tested by Meyer and had



Gas Engine Driven Electric Plant at Kuestrin Station.

power. The mean power on the brake was 341.5 horse-power, the speed being 101 revolutions per minute and the consumption of gas per brake horse-power was 81.5, while the thermal efficiency was 23.8 per cent.

The construction of the engine is of the two-cycle type, and has one motor-cylinder double acting like a steam engine, with a piston rod and cross-head working through guides and a crank. The discharge of burnt gases is through the ports and through an annular passage around the middle of the cylinder which is uncovered by the piston. The length of the double-acting piston is equal to the stroke, less the width of the exhaust ports. The gas and air enter the admission valves by separate pipes from two double-acting pumps, both driven by an auxiliary crank 110 degrees in advance of the motor crank.

ELECTRIC RAILWAY MANAGEMENT.

SOME OF THE POINTS BROUGHT OUT AT THE RECENT CONVENTION OF STREET RAILWAY MEN AT DETROIT.

These are all live topics and of interest to the electric railway field.

THE REGISTRATION OF TRANSFERS.

President Vreeland: This is an important subject to the members of this association. . . . It was a very hard matter to get any one to write the paper, and it has been absolutely impossible to get any one who would open the discussion on it.

Mr. Root, New York: I agree with Mr. Meneely, partly, when he says that the non-registration of the transfer does not eliminate entirely its cash value. . . . It has been our experience in New York, which is contrary apparently to that which Mr. Meneely has had in Brooklyn, that the non-registration of transfers does not make the conductors steal the cash fares—it has not that tendency. . . . This is more so in New York, on account of the great number of short riders, than in any other city in the country, probably, and for this reason more than any other we are very emphatic in our opinion that the non-registration of transfers is the best for our system; but I personally am of the opinion for any interurban or suburban road, where it carries passengers for long distances, and has few riders, and checks to a large extent the honesty of its conductors, through a comparison of the number of passengers in the car as against the number registered, the registration of transfers in that case may be advisable. . . .

Mr. W. R. Harrington, Camden, N. J.: We had been operating for some years up to last summer without registering our transfers. We had reason to believe there might be some trouble in connection with it, and we started to register the transfers last summer and did it for three months. Our secret service department showed such a wholesale trading in transfers that we stopped it, and since that time we do not allow them to register the transfers. We are not registering our transfers, and are of the opinion that we are pursuing the right course.

Mr. H. M. Sloan, Chicago: It seems to me if transfers are to be registered at all it should be done by a double register. My company was one of the first to put in the double register, and at the time we put the double registers in I was anxious about the outcome. . . . I found to my astonishment that there was very little of it.

Mr. E. G. Connette, Syracuse, N. Y.: The conductors of the Syracuse Rapid Transit Railway Company are required to register transfer tickets. It occurs to me that a non-registration of the transfer ticket only eliminates the value of the ticket to the conductor. It does not prevent the conductor from giving away transfer tickets to people along the road, or to agents at the points where they may be sold at a reduced price. The registration of transfers, of course, gives them the same value as a five-cent fare, and we use, as a rule, a single register, because we have not yet received an explanation of the advantage of a double register that would justify a separate register for five-cent fares and also a register for transfers.

Mr. John I. Beggs, Milwaukee: I thoroughly believe the necessity of giving to the transfer, and every other evidence of a right to ride on the cars, all the value that is given to a five-cent nickel paid on the car. Under our system the transfers are deposited in boxes at the terminals of the lines every trip. The conductor does not keep them until the end of the day, but they are placed in envelopes and dropped at the terminal points. He likewise does not keep his pad of transfers, but turns it over to the man who takes his run when he exchanges cars. If transfers are to be registered, I believe it should be done upon a double register; that does not necessarily mean two registers in a car, but a double dial. In our own practice, some four years ago, we adopted a double register which showed the number of passengers carried on any particular trip on one disc. We are at the present time, after a use of four years, arranging for an exchange of registers which will show the two classes of fares gathered on each trip, as well as the two totalizers. . . . Our system, controlling all of the interurban lines, centering in the city of Milwaukee, has ten or twelve possible commutation rate points, the tickets of which are given on our city lines to carry the passenger out into the suburbs, the tickets being sold to represent the commutation rate. Instead of two straight fares of five cents each, we may have a combination fare of seven and one-half cents, the passenger getting a transfer beyond the first fare point; consequently, on one of the discs which comes up on the register there are transfer tickets and three-cent fares, that comes up with a light-colored disc, and with the five-cent fare there comes up a red flag, and in this way the public is, to a certain extent, a detective as to whether the conductor is ringing up the class of fare which has been paid. We believe it facilitates the checking of a conductor, and I would not consider disregarding the value attached to a transfer. To our trained men it has all the value of a cash fare and is treated as such.

Mr. W. B. Tarkington, Council Bluffs, Iowa: We have also registered transfers. We can not understand why any one should ride and present something for his fare which the conductor is not required to ring up.

Mr. N. H. Heft, Meriden: I am willing to admit this is one of the subjects upon which I have spent considerable time racking my brain as to whether to register or not to register transfers. We have tried the system of not ringing the transfer and also the system of ringing the transfer. . . . As a general proposition I believe that every ticket received by a conductor as an evidence of fare should be registered.

THE STREET RAILWAY MUTUAL BENEFIT ASSOCIATION.

Mr. Connette: We feel that the Mutual Benefit Association, so far as our company is concerned, is a great success. The fees are deducted each month by the auditor of the company when the men are paid off, and the amount then is turned over to the treasurer of the association and deposited to its credit by him. All checks that are payable for sick and death benefits have to be approved by the general manager of the company before the checks can be paid by the bank, so that there is no possible way for any defalcation or for any diversion of the funds of the association. The board of trustees, which is composed of the employés of the company, is allowed one-half day each month on pay to assemble in the association rooms to discuss matters in connection with the management of the association, and to arrange for its monthly meetings. The secretary, who is one of the conductors on the road, is allowed two days each month on pay for the purpose of arranging his books and making up his checks to pay death and sick benefits, etc. Altogether, we feel that the Mutual Benefit Association of the Syracuse Rapid Railway Transit Company is a success from every standpoint.

Mr. Haggerty, of the Michigan Traction Company: I would like to ask the gentleman in case an employé is a member of the association and then leaves the company's service, what procedure does it take in regard to his membership?

Mr. Root: As soon as a man severs his connection with the company he severs his connection with the association.

Mr. Haggerty: Does he get any return for the money he has paid in?

Mr. Root: No, sir.

President Vreeland: If I may be permitted, just for a moment. The question asked by that gentleman is a question that has been asked very frequently, and the answer to that is, the Pennsylvania Railroad Company's Relief Fund. The Pennsylvania Railroad Company, which you know by its relief system, handles over $300,000 a year. It puts every case in a question and answer form and its proposition is that it is exactly the same as if you buy a traveler's insurance policy for twenty-five cents to protect you twenty-four hours, and you get that twenty-four hours' protection. It has done its duty and you get your return for your money. The Pennsylvania has always conducted its under that system and it has been sustained in it in the law. It has been one of the oldest and largest associations in the United States. The theory of it is a man pays fifty cents for a month's protection in the association, and all that goes with his protection. If a man leaves on the fifteenth of the month, he gets twenty-five cents back that he has paid. If he leaves the twentieth, he gets a proportionate amount. In a word, the idea

is that a man is not paying for anything but one month's protection when he pays under the system under which it is conducted.

THE TRANSPORTATION OF LIGHT EXPRESS AND PARCEL DELIVERY.

Mr. Connette: I would enquire of the author of the paper if the original franchise contemplated the hauling of freight through the streets of Detroit, and if not, what conditions did the city impose when it granted this right.

Mr. Parker: The original franchise, as I understand it, did not allow the Detroit United Railway to carry freight through the streets of the city, but an ordinance was passed granting that privilege. The original franchise did not specify anything, if I remember correctly, about carrying freight, but the electric express and freight system was started, and while it was not satisfactory at the beginning, owing to various conditions, such as plotting the streets, one thing and the other, the city council passed an ordinance prohibiting us from loading or unloading on the streets, compelling us to put up a depot of our own, and still further taxing us $1 per car per round trip, whether the cars are loaded or empty.

Mr. C. W. Wasson, Cleveland: I would ask the gentlemen if, judging from the moneys received, the business increases month by month.

Mr. Parker: It is only a year ago this month, as I remember, when the express service was started. The business shows some increase.

Mr. Crafts: I would ask Mr. Parker if he has noticed any material increase in the business of the passenger service, due to carrying packages and light express matter.

Mr. Parker: Yes, there is; it always has a tendency to increase the business.

Mr. Crafts: You think it gives you a marked advantage in carrying the package business, that is, that you gain in your passenger service.

Mr. Parker: Yes, sir.

President Vreeland: Under the conditions of operation that we have there (New York city), the company has nothing to do with the express service. The express company has a contract with the street railway company for operating on its tracks, and the business is only limited by the facilities which the express company has been able to establish at the present time. In other words, it has all the time at least thirty per cent more business offered it than it has had facilities to take care of. As fast as it has increased the facilities, the business has increased in larger ratio. As far as the question of the division as between the actual cost and receipts, based upon percentages, in the original operation of the system, which means, as you know, the operation of fifteen or twenty cars for the first six months to establish the business, the average of the whole would more than pay for the operation of the cars and the interest in the investment is paid by the express company, so that answers your question as far as we are concerned. There has been no expense entailed on our company in the operation of this service, even in its infancy. What the loss of the express company is, that is not so easy for me to answer.

THE STEAM TURBINE—ITS COMMERCIAL ASPECT.

Mr. John I. Beggs: I have read the paper on steam turbines with a great deal of care, for the reason that two years ago I postponed all progress in the construction of a power-house in which we expected to expend a large amount of money on units similar to those installed by the Manhattan Elevated Railway Company in New York, and are now being built in our city for the Subway Company in New York, because the matter of steam turbines was then being seriously agitated; and I did not wish to proceed with the work at that time and have some one say five years hence that it was a mistake to spend three millions of dollars on a power-house with reciprocating engines when it was about to be demonstrated that the steam turbine was destined to displace the reciprocating engine. Consequently, I have read this paper with a great deal of interest, and have gained from it some useful information. There is one point which has not been touched upon as fully as many others and that is the relative cost of the generator by itself to be connected to the steam turbine; in other words, you have left out apparently the differentiating cost as to the turbine itself and the generator to be connected to it. I would like to know whether your estimates of cost in the paper, when you say that the turbine costs less, means that the gradual or that the reduced cost is due to the reduced cost of the generator rather than to the turbines?

Mr. Sniffin: That question is not so material when you consider that these companies are either offering or expect to offer these turbine units as complete outfits. It makes no difference what the steam or electrical end costs individually, so far as we have the comparison of the cost of the complete unit. In a general way it may be said that the electrical end of the unit is lower in cost of manufacture than the large revolving generator that goes with a reciprocating engine. While the steam end itself is perhaps comparatively inexpensive, yet the price of the complete unit compared with the cost of the reciprocating unit, including its generator, is the comparison I made in my paper. It is not the purpose of the Westinghouse company to furnish the steam turbine alone, but to furnish the generator with it as a complete unit.

Mr. Beggs: . . . One of the important points, . . . is the effect of the greatly reduced cost of the generator to be attached to the steam turbine because of the high speed at which it must necessarily run. I believe the lowest speed at which it is considered you can make a large turbine operate successfully is about 750 revolutions per minute. Is that correct?

Mr. Sniffin: Yes.

Mr. Beggs: Those gentlemen know the difficulty we have had of getting the electrical manufacturers to build a generator of sufficiently low speed to operate satisfactorily with the larger types of Corliss engines that are now being built, and know how much they have had to pay because of the slow speed. In this matter of the development of our power-house, it became important whether or not we could cut down the revolutions of our engines, seven revolutions, from seventy-five to sixty-eight revolutions, which the builders of the engines said would measurably improve them from the operative standpoint; yet that reduction of seven revolutions per minute added greatly to the cost of the generator to be attached to that engine. It likewise added to its weight and made it almost impractical to construct the units to run at sixty-eight instead of seventy-five revolutions per minute. Consequently I think the generator, to operate with the steam turbine at 750 revolutions per minute, would be reduced possibly to seventy, and I thoroughly understand the great desirability of the two or three large electrical concerns to compel the purchase of the entire unit; but where there are only about two electrical manufacturers to-day that we might feel safe in—there may be a third in the future, and very likely a fourth, who can build a 5,000-kilowatt generator which we would be justified in making a contract for—there are almost a score of concerns in this country that can build a turbine to run at 750 revolutions per minute, because of the greatly reduced size and weight of the parts to be used.

Mr. Heft: I would ask Mr. Sniffin what history the steam turbine manufacturer has behind him, and what he proposes to give to the purchaser in the way of a guarantee as to the cost of maintenance if we buy this steam turbine?

Mr. Sniffin: . . . It is true the steam turbine has behind it not as many years of history as the reciprocating engine. It has, however, sufficient history behind it to show that there is no reason why a steam turbine, properly built, should not be less in maintenance cost than a reciprocating engine, which must be so by virtue of its very nature. I do not know what could be said about a guarantee of repairs; you could hardly get a guarantee of repairs on a reciprocating engine or any piece of moving machinery. That feature is gauged not only by its excellence of design and construction, but by the way in which it is handled.

Mr. Catta: I just want to ask Mr. Sniffin if the Central condenser plant could be used in connection with a turbo-generator instead of independent condensers for each unit. For instance, in a small size, up to 750 kilowatts, or in a plant of two or three or less units, an independent condenser would be necessary for each unit that is installed.

Mr. C. O. Mailloux, New York: I see no reason myself why it would not be possible to operate any number of units with the same condensing plant, though it might in very large units have a condenser for each unit. The cost of the condensing apparatus, as far as my investigations have disclosed it to be, is somewhat larger than the cost with an ordinary steam engine. This is due to many reasons. It is also a fact that the exhaust piping has to be done more carefully and is of larger diameter. That, however, is offset by many other advantages, one being the ability to use superheated steam of almost any temperature without mechanical detriment to the engine. I see no reason why you could not run a steam turbine at a point where it would be cherry heat, and glow in the dark, if there was any advantage in it. Of course, we all know there is a great advantage in superheating steam. I believe that the steam turbine in that respect is bound to be a very important element in a new way of using steam in steam engines.

THE ADJUSTMENT OF DAMAGE CLAIMS.

Mr. Beggs: Mr. Chairman, I feel constrained to say something upon this paper as a mark of respect to yourself, as presiding officer, and to the letter received, asking me to open the discussion upon this paper of Mr. Starrings. . . . There are one or two points in Mr. Starrings's paper that I particularly desire to lay stress upon, and that is the maintenance of an absolutely rigid policy as to dealing with all classes of claims regardless of who may be affected or what influences may be brought to bear to compel or induce the company to make more liberal settlements. It is not an unusual thing to have influential directors of the company, influential politicians, and sometimes directors, influenced by politicians attempting to prevail upon the agent to adjust some claim or to allow something in a case of some injury for which there is no legal liability. . . . I might say that in the history of the company I represent, my orders are, that in every case where there is a fair belief that the company is liable, to make a settlement if it can be done on any fair basis, and to make it as quickly as possible.

SIGNALS FOR URBAN AND INTERURBAN RAILWAYS.

Mr. W. B. Potter, Providence: I ask what provision is made in the signal system for the second or third car?

Mr. Palmer: I have no signal system. I am not here as the advocate of any signal system. I am simply here as an operative man.

Mr. Potter: I had reference to something I supposed you were using on the Old Colony system.

Mr. Palmer: We have several systems in use on the Old Colony road, one of which is the United States system, which is operated by an overhead contact and does not provide for the counting in of the cars after the block. The first car passes over the contact, sets the signal, and the first car out, unless the trolley is removed from the wire, clears it. That feature I regard as a valuable one. I think for any system to be reliable and safe, that it should be absolutely impossible to clear the car while there is another car on the block from one end to the other. We have also in use in the Randall system which, as you all know, is simply a circuit of incandescent lamps, hard at one end, and hard at the other end of the block, and which with us is more efficient as a lightning arrester than as a signal. I do not know that it should be considered a signal.

DISCIPLINE OF EMPLOYÉS BY THE MERIT SYSTEM.

Mr. Harrington, Camden, N. J.: . . . The interest taken in the subject of discipline, the method, the rule of procedure and the relation the employer should bear to the employé has never been greater than at the present time. The individuality of the employer has as much to do with the results of any system of discipline, if not more, than the system itself. A system is not the panacea. It is conceded by all that the old method of suspension for violation of rules is not fruitful of results. I have tried the suspension system, the merit and demerit system, and abandoned them both after careful and persistent trial and effort. The promotion system was first put into effect upon our railway just about two and one-half years ago, and has been gradually developed into a thoroughly operative, practical system and conducive to the best results. Under this system an employé for any irregularity is notified that he will be demoted one or more points on the seniority list if proper explanation be not made on or before a specified date. This notice, with an account of the irregularity, is posted on the bulletin boards at the meeting places of the men. This usually results in the men whose names are posted arranging to meet the general manager, affording an excellent opportunity to exercise judgment in enforcing discipline. The wholesome effects are most noticeable, and efficient and reliable employés under this system forge gradually and surely ahead, obtaining the best and most profitable runs at the disposal of the company, and in such men the general stability of the working force is maintained against any possible disaffection upon the part of the men suffering from demotion. It can be seen that this system, while not directly taking cognizance of the efficient employé, in fact, does take the most pronounced action in his behalf.

International Association of Municipal Electricians.

The following were elected members of the International Association of Municipal Electricians, at Richmond, Va., October 7, 8 and 9, 1902: Fred W. Hart, city electrician, Denver, Col.; W. L. Kent, city electrician, Lynchburg, Va.; Edward P. Leonard, superintendent fire telegraph, St. John, New Brunswick; James McManus, superintendent fire telegraph, San Antonio, Tex.; Jacob B. Platt, superintendent fire and police telegraph, Augusta, Ga.; O. M. Schafer, superintendent fire and police telegraph, Trenton, N. J.; C. L. Williams, city electrician, Meridian, Miss.; H. E. Waterstreet, superintendent fire telegraph, Amsterdam, N. Y.; W. R. Brixey, Day's Kerite Company, New York; Charles Worden, superintendent fire telegraph, Jackson, Mich.; E. B. Baker, New York; W. H. Bradt, superintendent fire telegraph, Troy, N. Y.; C. E. Beach, Star Electric Company, Binghamton, N. Y.; J. B. Yeakle, superintendent fire telegraph, Baltimore, Md.; H. G. Ferguson, manufacturer incandescent lamps, St. Louis, Mo.; George L. Fickett, city electrician, Portland, Me.; Frank F. Loomis, city electrician, Akron, Ohio; Leon Sullivan, city electrician, Decatur, Ill.; John Leininger, city electrician, Canton, Ohio; James F. Burns, city electrician, Schenectady, N. Y.; Charles A. Hofses, superintendent fire and police telegraph, Reading, Pa.; W. J. Denver, assistant general manager National Electric Telephone and Telegraph Company, Boston, Mass.; Charles G. Sundquist, superintendent municipal electric lighting plant, Jamestown, N. Y.; Foote, Pierson & Company, electrical manufacturers, New York; Kellogg Switchboard and Supply Company, Chicago, Ill.; E. E. Beam, superintendent municipal lighting plant, Ashtabula, Ohio; Frank Shinen, assistant city electrician, Atlantic City, N. J.

The Technology Quarterly, Published by the Massachusetts Institute of Technology.

The September issue contains the proceedings of the Society of Arts from March to May, 1902. An article by Mr. Louis Derr on "The Efficiency of Photographic Shutters," gives some very interesting experimental results. "The United States Geological Survey Topographic Slide Rule," is illustrated and described by Mr. G. H. Matthes. Mr. W. L. Crosby contributes "A Study of Hard Packed Sand and Gravel." "Smoke and Its Abatement in Large Cities" is treated by Mr. C. H. Benjamin, and Messrs. W. R. Whitney and A. G. Woodman contribute a long article, fully illustrated, on "The Microscopic Examination of Paper Fibres." The number is concluded with "Contributions from the Laboratory of Sanitary Chemistry," the subject presented here being notes on Oscillaria prolifica, by the Misses Elizabeth F. Hyams and Ellen H. Richards.

Eighth Annual Meeting Ohio Electric Light Association.

Proceedings and Discussion at Columbus, Ohio.

THE eighth annual meeting of the Ohio Electric Light Association was held October 14, 15 and 16, at the Chittenden Hotel, Columbus, Ohio, and, in the absence of President White, was called to order by Vice-president McKnight, of Middletown, who presided over its deliberations and contributed materially to the success and interest of the meeting. Mr. McKnight, being at the head of two electric light plants—in Middletown and Bowling Green, respectively—and president of an electric railway line, is in a position to know whereof he speaks, and his address at the opening of the convention was full of practical suggestions, as well as recalling some interesting reminiscences of the formation of the Ohio association. While fully alive to the interests of the capitalization of his companies and keen to perceive and adopt every suggestion looking to increased efficiency of operation and economy of cost, Mr. McKnight believes that the way to make the people your friends is to treat them as if they were, and this policy he endeavors to carry out. He urged that, without being subjected to unnecessary annoyances, electric lighting companies be encouraged to give the very best possible service at the least cost to consumers, and that they be made secure in a reasonable return for their capital invested and risk assumed. Mr. McKnight's suggestions later on in the meeting with reference to installation of heating plants as a by-product were listened to and appreciated very much.

The following were in attendance from central stations: E. J. Bechtel, electrical engineer and superintendent lighting, Toledo Railways and Light Co.; E. H. Bell, Youngstown Consolidated Gas and Electric Co.; E. A. Beckstein, Sandusky Gas and Electric Co.; Albert Charles Blinn, general superintendent Sandusky Gas and Electric Co.; M. S. Browne, Columbus Edison Co.; Joseph Brooks, Columbus Edison Co.; Frank Espy, Kenton Gas and Electric Co.; A. W. Field, Columbus Edison Co.; D. L. Gaskill, president Greenville Electric Light and Power Co.; John Whitely, director Greenville Electric Light and Power Co.; E. F. Gwynn, general manager Delaware Electric Light, Heat and Power Co.; George Hayler, Jr., manager Van Wert Gas, Electric Light and Power Co.; W. F. Hubbell, proprietor Wauseon Electric Light Plant; M. C. Hull, Columbus Edison Co.; Walter Jaynes, Columbus Edison Co.; David S. Kohler, chief engineer Columbus Edison Co.; C. R. Lutz, Citizens' Electric Light Co., Logan, Ohio; R. H. McCoy, Kenton Gas and Electric Co.; E. H. McKnight, Citizens' Light, Heat and Power Co., Bowling Green, Ohio, and Middletown Electric Light and Power Co.; Geo. Matt, Lancaster Electric Light Co.; John Miller, Springfield Light and Power Co.; Joseph P. Myers, Chillicothe Electric Railroad, Light and Power Co.; J. H. Perkins, Youngstown Consolidated Gas and Electric Co.; J. M. Plaisted, Columbus Edison Electric Co.; W. F. Raber, Citizens' Electric Railway, Light and Power Co.; Mansfield, Ohio; O. W. Rhoads, Columbus Edison Co.; A. C. Robeson, Greenville Electric Light and Power Co.; S. M. Rust, Piqua Electric Co.; T. J. Smith, New Lexington Electric Light and Power Co.; W. D. Somers, Columbus Edison Co.; Frank E. Valentine, Urbana Electric Light and Power Co.; L. G. White, superintendent Electrical Depot, Columbus Edison Co.; H. C. Dye, superintendent Municipal Electric Light Plant, Galion, Ohio; Lehman B. Hoit, M. E., Cleveland, Ohio.

The following representatives from supply houses were present: W. W. Affleck, John A. Roebling's Sons Co., Cleveland, Ohio; F. J. Alderson, Stanley Instrument Co., Great Barrington, Mass.; Perry R. Boole, Electric Appliance Co., Chicago, Ill.; Frederick Bissell, president the F. Bissell Co., Toledo, Ohio; W. Gibson Carey, General Electric Co., Schenectady, N. Y.; F. H. Carpenter, Nernst Lamp Co., Westinghouse Lamp Co., Pittsburg, Pa.; Charles W. Cobb, Western Electric Co., Cleveland, Ohio; F. C. Colwell, manager General Incandescent Arc Light Co., Cincinnati, Ohio; Frank Conrad, Westinghouse Electric and Manufacturing Co., Pittsburg, Pa.; H. P. Davis, Westinghouse Electric and Manufacturing Co., Pittsburg, Pa.; H. J. Douds, General Electric Co., Cincinnati, Ohio; James R. Downs, Westinghouse Electric and Manufacturing Co., Pittsburg, Pa. (Cleveland); G. B. Fairbanks, Electric Appliance Co., Chicago, Ill.; W. J. Hanley, General Electric Co., Cincinnati, Ohio; W. A. Hopkins, the Erner-Hopkins Co., Columbus, and the Motor Truck and Vehicle Co., Columbus, Ohio; W. F. Howe, Jr., General Electric Co., Schenectady, N. Y.; R. E. Hull, the Erner-Hopkins Co., Columbus, Ohio; Wesley P. Jend, Westinghouse Electric and Manufacturing Co., Pittsburg, Pa.; F. M. Knierim, the F. Bissell Co., Toledo, Ohio; E. Kuhlman, Kuhlman Electric Co., Elkhart, Ind.; Charles S. Kuntz, the Post-Glover Electric Co., Cincinnati, Ohio; Waldo Arnold Layman, Wagner Electric Manufacturing Co., St. Louis, Mo.; C. R. McKay, General Electric Co., Cincinnati, Ohio; J. W. Mason, Central Electric Co., Chicago, Ill.; Charles D. Meyers, Helios-Upton Co., Philadelphia, Pa.; W. D. Packard, New York & Ohio Co., Warren, Ohio; Nathaniel Paige, Jr., Westinghouse Electric and Manufacturing Co., Pittsburg, Pa. (Columbus); E. J. Paradis, the W. G. Nagel Electric Co., Toledo, Ohio; Allen S. Pearl, Central Electric Co., Chicago, Ill.; M. A. Pixley, the Erner-Hopkins Co., Columbus, Ohio; Thomas J. Ryan, Fort Wayne Electric Works, Cincinnati office; George S. Searing, Hart & Hegeman Manufacturing Company, Hartford, Ct., and Peru Electric Manufacturing Co., Peru, Ind.; H. T. Stewart, General Electric Co., Cincinnati, Ohio; Chas. J. Wells, Fostoria Incandescent Lamp Co., Fostoria, Ohio; W. H. Whiteside, Westinghouse Electric and Manufacturing Co., Pittsburg, Pa.; Albert H. Wright, Otis Elevator Co., Cleveland, Ohio; Edwin Yawger, Westinghouse, Church, Kerr & Co., Pittsburg, Pa.; C. R. McKay, General Electric Co., Lynn, Mass.; L. T. Levy, sales agent for L. E. Frorup, New York city.

The following new members were admitted: The General Electric Co., Cincinnati, W. J. Hanley, agent; General Incandescent Arc Light Co., P. H. Klein, secretary-treasurer; the Erner-Hopkins Co., Wm. A. Hopkins, Jr., treasurer; Louis T. Kaiser, chief engineer Thomas Emery's Sons, Cincinnati, Ohio; the Cleveland Electrical Manufacturing Co., A. B. Foster, manager; Pass & Seymour, Solvay, N. Y., B. E. Salisbury, secretary; the W. G. Nagel Electric Co., W. T. Nagel, president and general manager; the Fort Wayne Electric Works, F. S. Husebury, treasurer; the Electric Supply and Manufacturing Co., C. T. McKinstry, secretary, Cleveland; the Westinghouse Electric and Manufacturing Co., C. S. Powell, manager, Cleveland; Illinois Electric Co., F. E. Healy, president, Chicago, Ill.; the Standard Electric Co., F. D. Lawrence, president, Cincinnati; the Bryant Electric Co., E. K. Patton, western manager; the Central Electric Co., George A. McKlintock, president; the Adams-Bagnall Electric Co., Cleveland, E. J. Bagnall, general manager; the Wagner Electric Manufacturing Co., St. Louis, W. A. Layman; John A. Roebling's Sons Co., Cleveland, W. P. Bowman, manager; Stanley Instrument Co., New York, Francis H. Wall, general sales agent; Doubleday-Hill Electric Co.,

Chas. Phillips Hill; the Post-Glover Electric Co., Chas. S. Kuntz; the F. Bissell Co., Toledo, Ohio, C. A. Perkins, secretary and treasurer; Westinghouse, Church, Kerr & Co., Edwin Yawger; Electrical Appliance Co., Chicago; the Fostoria Incandescent Lamp Co., J. R. Crouse, president and general manager.

Mr. Edward Yawger, of the Westinghouse, Church, Kerr & Company, Pittsburg, read a paper on "The Present Development of the Steam Turbine," accompanying it with blue-prints illustrating a number of tests made on a 400-kilowatt turbine. He gave a general description of the design and principles of the machine, and its great mechanical simplicity as compared with the modern reciprocating engine, pointing out that the governing mechanism, not being called upon to control the steam in any way after it has passed the admission valve, this can be very simple and more remotely connected with the turbine itself. For the turbine is claimed—increased economy, better regulation, smaller repair and maintenance account, and reduced installation cost as compared with a given standard of economy; also smaller percentage of depreciation. The paper elicited considerable discussion showing an interest in the subject, the discussion taking the line of requests for further details as to how small turbines could be manufactured, variation of efficiency with varying load, relative speed, etc. Mr. Yawger stated that it was easier to run a steam engine in parallel with a turbine than with another steam engine. In reply to a query by Mr. McKnight, the author stated that he thought the comparative cost of a 400-kilowatt turbine and that of an engine of high grade and same capacity would be very nearly equal, although the less cost of foundations and building required would tend to bring down the cost below that of a reciprocating engine plant. The tendency would be toward a cheaper installation all along the line in the case of the turbine.

The topic following was: "On what lines shall we reach new business to improve our load curve and increase our net earnings?" Papers on this question were submitted by Messrs. E. J. Bechtel, superintendent of lighting, Toledo Railways and Lighting Company; Mr. George Hayler, Jr., manager Van Wert Gas, Electric Light and Power Company, and Mr. L. G. White, superintendent electrical department, Columbus Edison Company, followed by general discussion. Mr. Bechtel's reputation for suavity is well established, and being energetic and progressive as well, his suggestions came with added force. He contended that gas being a concededly cheaper illuminant (Mr. Bechtel comes from a natural gas city) the effort should be to increase the efficiency and reliability of the electric service to such a degree that it shall have preference so as not to tempt people to forsake it because of accidental breakdowns and establish habits of using gas which may cling to them thereafter. In determining rates of charges for a station operating different systems the respective load curves should be considered separately rather than the station load curve as a whole. That system of charging which stimulates long-hour burning is best. In Toledo a systematic method of employing card indexes is practised so as to keep track of the conditions with different consumers; this the contract department has access to. This department should be in the hands of courteous, gentlemanly, enthusiastic and business-like men who have at heart both the good of the consumer and the company. This department should keep in close touch with architects' clubs and individual architects. Mr. Bechtel advocated judicious advertising, souvenir novelties, etc. The credit and contracting departments should be in no wise connected. Meters should be properly looked after and maintained.

Mr. White, of Columbus, urged personal soliciting. In towns too small to admit of the time of one man being solely given up to this feature, some certain portion of his time should be set apart for this. The most desirable load curve for daylight hours is the motor load. Electric elevators are good business. Many small shops can be secured who do not at present employ power, and when power is introduced they will probably use more and more light on dark days, when otherwise it would not be employed. The load curve can be materially improved by the substitution of the enclosed arc lamp in place of the incandescent. Where a shopkeeper has, say, a dozen incandescents, he will turn on every other one during a part of the burning hours, whereas if the arc was installed of capacity equalizing the aggregate of incandescents it would be turned on at first and kept on all through the period. Attention should be paid to the matter of rates.

Mr. George Hayler, Jr., of Van Wert, Ohio, then read his paper.

In the discussion following, Mr. Bechtel said he thought there was more lost in poor contracting and in consumers that are not secured, because not solicited properly, than in any other part of the system. Mr. Perkins held that in many cases it would be possible to suit a customer with respect to rates providing his wants varied from the usual lighting hours. In Youngstown a card system was maintained of agreements and special arrangements to suit certain conditions, so that when any one else had to take the same matter up he would approach it sufficiently informed. They had in his city accomplished much by supplying railway service; electric elevators and machine shops had also proved profitable sources of revenue for the use of single phase, whereas it would have been almost impossible to do this in some outlying districts with any other system.

Mr. Fairbanks incidentally referred to the case of the Ferrell Foundry and Machine Company, of Ansonia, Ct., which had found that it could run an exhaust steam-heating plant (for its works) combined with an electric drive with just one-half the boiler instalment that it had employed for a high-pressure heating system. The discussion then took a side line referring to the subject of steam heating and hot-water heating, which was taken up the day following under the regular assignment. It here developed that Mr. Gwynn and Mr. McKnight differed totally in their ideas as to charging or estimating cost of heating, Mr. Gwynn holding that it was policy to heat only one room if a consumer desired only that, and Mr. McKnight's plan being to require the consumer to take heat for the entire residence radiation. Mr. McKnight employs thermostats, while Mr. Gwynn does not, but practically makes his plant a thermostat for the entire system.

Secretary Perkins explained that he had made every effort to secure an essayist on the steam end of the heating proposition as a by-product but without success.

Mr. Colwell wished to know if any one had an appreciable load from electric cooking, and if that would ever amount to anything. Mr. McKnight stated that he had cooked flapjacks against his wife, she using a coal stove and he an electric one, and he had his on his plate some minutes ahead. He was asked if he had made any estimate of comparative cost, and replied that he had not treated the matter that seriously. A gentleman present reported that in Traverse City, Mich., the current had been purchased to some extent for a fad of chafing-dishes, etc., bills that had been $2.50 running up to $5 and $6 a month. During some months of the year this might be a profitable branch. Mr. McKnight again

called attention to the value of introduction of current for any other purpose as valuable in stimulating its use for lighting, as if it was on the premises its great ease of use would tend to its use for light. He had in Middletown a number of electric sadirons taking current, and heard no complaint on the score of cost. Mr. Bechtel reported curling irons employed in Toledo to some extent current; also warming tables and sadirons; it was very handy to heat water in a sick room, etc. Mr. Raber, of Mansfield, gave a special rate for electric automobiles provided they were not run during the peak, and had found this profitable business. Mr. Bechtel reported same, his rate being three cents. Mr. McKnight several years ago adopted the idea of furnishing lamps, but now thought it bad policy. He now held it better to charge for all supplies. It was objected by some that if the consumer bought his own lamps he might buy a poor article and indirectly reflect upon the quality of light furnished, but Mr. McKnight in such case felt his own conscience was clear. Mr. Perkins instanced a case where a certain manufacturer who had a good many renewals thought he could buy his lamps cheaper and did so, but the lamp used so much more current that it proved a losing speculation, and the manufacturer was glad to purchase thereafter of the company. Mr. Raber reported that they had had trouble with excessive lamp renewals, and had kept track of their renewals for a considerable period and after ascertaining the percentage, increased the price of current sufficient to cover that item, and it was now no longer a matter that concerned them. They sold their lamps at cost in some cases; in others furnished them free on renewals. Mr. McKnight saw no objection that could reasonably be urged to making a fair charge for all material supplied consumers; otherwise the station would lose out.

The above completed matters taken up on Tuesday, the evening of which day was passed at the Empire Theatre, an entire section of boxes being reserved for the members and their ladies, with compliments of the Columbus, Edison and the Erner-Hopkins companies.

On Wednesday morning the first subject for discussion was:

(*a*) What is the present state of meter development?

(*b*) How shall we handle our meter department to obtain—(1) Least cost of operation; (2) least disturbance to consumers; (3) maximum efficiency?

Papers in reply were presented and read by Messrs. F. G. Vaughan, of the General Electric Company, Lynn, Mass.; H. P. Davis, of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and Mr. F. J. Alderson, of the Stanley Instrument Company, Great Barrington, Mass.; on the part of the central station, by Mr. E. H. Beil, of the Youngstown Consolidated Gas and Electric Company.

Mr. Vaughan after pointing out the various kinds of meters that could now be obtained for various purposes in the open market, said that the behavior of meters should be studied with reference to varying conditions, such as variation of frequency, variations in voltage, different conditions under inductive and non-inductive and mixed loads, also when current is supplied from different types of machines affecting the wave-forms. The longest life, compatible with efficiency, is important. Laboratory tests are not alone sufficient, but meters should be tested carefully under actual conditions of service. Annual inspections were necessary. The writer considered methods of testing, and contended for inspection upon premises in all cases. Manufacturers, he stated, are giving the meter problem close attention with a view to securing the best results for all concerned. Mr. Davis's contribution to this question was entitled, "Some pertinent features of the modern meter." After referring to the excellence to which the modern meter has been brought by manufacturers, it was pointed out that the causes which preclude permanency are (1) aging of the permanent magnets; (2) variations due to changes of voltage, temperature, frequency, etc.; (3) wear upon the bearings. Manufacturers fully realize the difficulties to be met and are bending every effort to meet and remedy same. Friction is the most important source of error, as resulting chiefly from the weight of the moving part and consequent wear. His paper considered this element of friction in some detail, and its causes; also the relation which torque bears to the friction as affecting accuracy of the meter. He strongly advocated the importance of a high ratio between torque and friction, this to be obtained by high efficiency through minimizing friction and at the same time keeping the weight of the moving elements at as low a figure as permissible for strength. He described a new cup and ball bearing which are designed to fulfill this condition, and which, it is claimed, tests made at the engineering laboratory of the Westinghouse Electric and Manufacturing Company have demonstrated the advantages of.

Mr. Alderson's paper while not directly referring to the Stanley meter enumerated points of excellence that are claimed especially for it. The writer maintained that every meter should be tested before it is put upon the line and the manufacturer held to his guarantee if the meter fails to respond to test. It is a prevalent custom for electric companies to adopt a meter for testing purposes of the same make as they are using on their lines as a standard. This is not good practice, for the same meter may be developing faults peculiar to that make and consequently lost sight of. Undoubtedly the best method of test, according to the writer, is to use an indicating wattmeter in series with the recording wattmeter to be tested. Testing by "tested" lamps is unreliable for close results. The results secured by magnetic suspension were referred to and commended, and the importance of the most accurate meters in removing causes of dissatisfaction on the part of consumers emphasized.

The discussion on this subject was somewhat lengthy, and developed variation in practice among station managers, some holding that meters should remain permanently in adjustment without necessity for frequent inspection. Mr. Field considered that this was as unreasonable as if a man were to expect his watch to remain a good timekeeper without being given a periodical cleaning and oiling up. Mr. Perkins said that at his station a card index was kept of meters, and if variations in bills occurred which could not be accounted for otherwise the meter was at once examined and inspected, without waiting for the customer to complain; so far as possible complaints were anticipated and their cause enquired into in advance. Many of his customers were in the habit of sending notice to the office if an extra amount of light would be required for an especial occasion. By keeping track of this it was often possible later on to reconcile the increased bill satisfactorily to the consumer.

Mr. E. H. Beil, of Youngstown, in his paper stated that inefficient meters are a constant source of dissatisfaction and loss of custom. Meter cases should be well made, stiff and dust-proof, and should require the minimum amount of skill in installing. Terminals do not receive sufficient attention from manufacturers, and should be made heavy and have at

least two good screws for securing the wire in same. Meters should be so set that the heat generated by a poor contact will not destroy the entire meter. Means of adjustment should be provided so that the meter may be easily calibrated. The moving element to be as light as possible, and sliding contacts minimized. In Youngstown a testroom has been established with both alternating and direct-current instruments for testing. The stop-watch method is used, and a running test sometimes made to determine whether the recording dial is all right. All meters are tested when received from the manufacturer, and thereafter as may be found necessary by occurrence of variance in consumers' bills, etc. No regular inspection is made. One thousand two hundred meters are installed. Of 800 Westinghouse meters in use, some fifty required repairs to shafting or jewels, etc. Of a lot of Stanley meters received about eighteen months ago none has required any repairs. Of thirty other meters installed it is said the most trouble has been experienced with same. However, a comparison of these as used on a 500-volt circuit would probably be invidious as they are then operating under altogether different conditions; but the experience with them at this station has not been satisfactory.

Professor F. C. Caldwell, at the head of the electrical engineering department of the College of Engineering of the Ohio State University, being in attendance, invited the association to visit his department Wednesday evening and view the apparatus installed, and also witness the operation of the new Nernst lamps. A vote of thanks was returned, and the invitation was availed of very generally, special trolley cars being provided for the conveyance of the party. They were received at the university by Professor Caldwell, and addressed by Professor Edward Orton, dean; Professor Embury Asbury Hitchcock, M. E., professor of experimental engineering, and Wm. T. Magruder, M. E., professor of mechanical engineering, also assisted in receiving and entertaining the visiting body. This university has now some 1,600 to 1,800 students. A number of students from Professor Caldwell's class in engineering attended the sessions of the convention upon invitation, which, by vote, was extended to the faculty and students.

Wednesday afternoon the convention was addressed upon legislative matters referring to the proposed municipal code and the proposed repeal of the arc light bill heretofore passed at the instance of the railroad companies, by Mr. D. L. Gaskill, chairman of the advisory committee.

This was followed by papers and discussion upon hot-water heating as an adjunct to electric lighting plants, a topic to many of the station managers of growing importance and in which they were greatly interested.

Acting President McKnight, of Middletown, submitted the first paper on this subject, the opening sentence of which furnishes the keynote to its contents. Mr. McKnight says: "Owners of electric lighting plants have long desired to increase the earning capacities of their properties without appreciably additional expense. This has led to an investigation of the utility of exhaust steam as a means of heating buildings. Wherever this business has been added to an electric light plant it has proven its salvation, especially where competition has been keen and profits small." This paper will be read with interest by all central station managers whose conditions locally enable them to take advantage of the opportunity resented. It is especially applicable to smaller cities which are not too small to permit of a fair day load, or where in such cities a day load can be created otherwise.

Mr. E. F. Gwynn, of the Delaware Electric Light and Power Company, followed, and gave a detailed description of his method of installing the heating system, construction of trenches, laying of pipe and properly covering and protecting same. In the discussion following Mr. Gwynn stated that his company had, during the last winter and covering the twelve months then ending, paid a coal bill of $6,800 and sold heat to the amount of $7,800, with an increased operating expense in coal bill over the previous year, when the system was not in use or installed, of something like $1,000. In the heating plant proper there was represented an investment of some $32,000. There must also be considered interest on this investment of some $1,600. The average horse-power last winter was 190 for the day; he had horse-power up to 425 installed. Mr. Hayler, of Van Wert, reported that his company was selling heat, and had to use live steam at times last year simply because it had no day load. The coal bill for five months from November 25 until close of the season was increased not quite fifty per cent. If the company could operate the lighting plant continuously for twenty-four hours, it could afford to sell its current at a sufficiently low price to pay for fuel, then the gross returns from heating would be net profit.

Mr. Hoit, of Cleveland, held that where it is possible to secure water for condensing, and particularly in plants where they have no day load, a better revenue could be secured than by attempting to use exhaust steam for heating purposes. If it is possible to maintain a day load on the plant equal to a light load, so that the plant will be in operation for twenty hours out of the twenty-four, the advantage gained by using the exhaust steam for heating is about the advantage gained in condensing. However, the cost of the investment on installation for heating purposes must be considered as a matter of expense, to be charged against the heating system as compared with a condensing plant.

Thursday morning, at the request of Vice-president McKnight, Mr. D. L. Gaskill, of Greenville, took the chair and conducted the remainder of the meeting. Upon calling the session to order he referred to the fact that several years ago, before this association, the General Electric Company had one of its engineers read a paper upon the subject of enclosed series alternating-current arc lamps. At that time the matter was not viewed with the seriousness that its importance, as since developed, justified, but its growing adoption made it a very interesting subject, and he felt that the papers that would be read bearing upon this question would be highly appreciated.

Mr. C. R. McKay, of the General Electric Company, Lynn, Mass., presented a paper on the topic, "What is the reliability, regulation, power-factor and efficiency of present forms of alternating-current series arc lighting apparatus?" with reference to constant-current transformer systems.

Mr. Thomas Spencer, of the Helios-Upton Company, Philadelphia, was unable to be present. His paper was read by the secretary, referring to the topic last mentioned above, with especial reference to inductive regulator and step-up transformer system. He thought that the most important question to be considered in connection with the subject was the relative advantages of differential and shunt lamps for use on alternating-current circuits. He was of the opinion that the shunt lamp does not materially assist the regulator, and that the differential lamp would avoid the danger of "pumping." Carbons are together in the differential, also when the lamp is not

burning, and the cutout is mechanical and can be made very simple, thus assisting the reliability of the system. On account of the presence of the series coil in the differential the terminal average is necessarily higher than that of the shunt lamp, and more than that, it is not possible to change the current on the line without readjusting differential lamps, which can be done with the shunt. The system considered shows up a very good efficiency of ninety-five per cent. Where transformers are used this efficiency is lowered to about ninety-one per cent. To a certain extent the efficiency decreases when the system is operated at less than full load. On the whole, series alternating-current arc systems, as now operated, are in every way a commercial success, and will certainly grow in favor as time goes on and the good points are better understood.

Mr. W. A. Layman, of the Wagner Electric Manufacturing Company, St. Louis, presented a paper on "Variable secondary step-up transformer system."

Mr. Bechtel, of Toledo, reported very good results with three 100-light transformers in operation for one to two years and a half; service reliable and no repairs. Their experience had taught them it was better to burn up lightning arresters in the station than cable outside that could not be so easily repaired. Three hundred alternating-current lamps, besides seventy-five direct-current enclosed, were taken care of by one trimmer with a wagon equipment and trays. In the winter, trim once every five days; in fall and spring, once every six days; in summer, once every seven days. He desired to know of the supply men what impedance is absolutely necessary in a circuit to ensure steadiness of light. Mr. McKay replied that when an underground cable had been in use for some time it is rather hard to tell just what may be happening to it; there might have been a weak spot in the cable to cause the unsteadiness complained of, but it is not likely that the unsteadiness was due to the carbon resistance being in circuit.

Mr. Layman said that in regard to how much self-induction was necessary to keep the lamps nicely balanced, Mr. Spencer had recommended seventy-five per cent, but he thought a lamp circuit could be burned with excellent results with a power-factor of eighty-five per cent—eighty-four or eighty-five per cent. Mr. Perkins thought about eighty-one per cent. Mr. Layman thought this depends on the construction of a particular lamp. Mr. Perkins referred to the matter of arrangement of circuits, and said he had had occasion to rearrange the Youngstown circuits using the station as the centre of distribution, running the different circuits out radially like the spokes of a wheel. Circuits should be laid out originally with an average of forty lamps, leaving leeway for additions. A better power-factor should be sought for on lower loads. Mr. Bechtel believed it was necessary to be careful not to lay out too many circuits so as to avoid increasing the fixed charges for copper investment and for extra transformers. The fixed charge expense will almost offset the expense of rearrangement complained of by Mr. Perkins. Circuits when laid out should be so laid out that they can readily be changed.

Mr. Doud stated that his company did not now recommend the use of single circuits of 100 lights, but rather to limit to seventy-five lights.

Mr. Gaskill stated that his company had lately installed for street lighting alternating-current 7.5-ampere lamps using two 50-light tub transformers, and although at first some opposition was experienced he doubted if now the people would go back to the former system. The company's plant was of the size usual in towns of 5,000 to 7,000 inhabitants; present installation 300 kilowatts capacity. Had formerly been using a well-known open arc system. Originally it had operated very satisfactorily, but of late years the cost of repairs was excessive and depreciation rapidly increasing. The company had contracted with the city some seven and one-half years ago for a ten years' term at $84.50 per lamp. It had been able by the present change in system, to offer a lower rate and to secure a renewal of its contract for another ten years, while reducing its operating expense materially. The present contract called for $78 per lamp, 7.5 amperes, with a guaranteed delivery of 450 watts at the lamp terminals. Under the Ohio law the council can not make a contract that does not go into full force during its term of office, and therefore could not consider a bid from other parties if offered, but by the present company making the offer at a reduced rate before the expiration of existing contract an arrangement was consummated satisfactory to all parties. The suggestion was offered for others.

Mr. Beckstein, of the Sandusky Gas and Electric Company, was using the transformer system for the past five or six months. He referred to great saving in operating expense secured thereby. Mr. Bechtel confirmed this observation.

After some further discussion along this line, the papers programmed having now all been heard, and the hour of noon approaching, the convention voted to take up routine business. The report of the executive committee, Mr. Bechtel, chairman, and of the finance committee, Mr. Raber, chairman, were made and approved, it appearing that the treasury was in good condition and the accounts of the secretary-treasurer, Mr. Perkins, all correct. A vote of thanks on motion of Mr. Bechtel was tendered to the Columbus Edison Company, the Erner-Hopkins Company, the Columbus Street Railway Company, the Ohio State University and the College of Engineering, the Chittenden Hotel and the press, for courtesies and entertainment provided.

Columbus was adopted as the next place of meeting, the time to be fixed according to the provisions of the constitution. It was considered by some members that the date of October is too late and too far into the busy season, and August was favorably spoken of as a suitable date. The report of the secretary-treasurer was read and approved, and a special vote of thanks returned to Secretary Perkins and Vice-president McKnight for their labors during the year and in preparing the programme for this convention. On motion of Mr. McKnight, a vote of thanks was tendered to the various essayists.

The following officers were elected for the ensuing year:

President—A. W. Field, Columbus, Ohio.

Vice-president—S. M. Rust, Piqua, Ohio.

Secretary-treasurer—J. H. Perkins, Youngstown, Ohio.

Advisory committee—D. L. Gaskill, Greenville, Ohio; E. J. Bechtel, Toledo, Ohio; Samuel Scovil, Cleveland, Ohio.

Executive committee—E. H. McKnight, Middletown, Ohio; George Matt, Lancaster, Ohio; F. E. Valentine, Urbana, Ohio; W. F. Hubbell, Wauseon, Ohio; A. C. Blinn, Sandusky, Ohio.

Finance committee—George Hayler, Jr., Van Wert, Ohio; W. F. Raber, Mansfield, Ohio; John Miller, Springfield, Ohio.

Mrs. A. W. Field, with other ladies of Columbus, was assiduous in her attention to the visiting ladies, entertainment for whom was especially provided in the shape of an electric automobile drive through the city, theatre party, and lunch at the Country Club. The only regret was that not more of the members brought their ladies.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

New South Wales Government Railways and Tramways Annual Report.

The report of the railway commissioners for the year ending June 30 has been presented to Parliament. Generally speaking, the results are more favorable than was expected. In regard to the tramways, the report shows that considerable progress has been made during the year, the capital expended on the system being nearly $15,000,000; 104 miles of line being open for traffic, an increase of twenty-five for the year. The tramways are situated in Sydney and Newcastle, with a small line in Broken Hill. Those in Sydney are largely built on the electrical system, and other methods of traction are being superseded by this. The profit, after paying working expenses, was $450,000. — *Railway News* (London), October 4.

Present Cyanide Practice.

The following is an outline of a method given by Mr. R. O'Brien of the Australian practice in cyanide plants. The tailings are usually treated with lime, the quantity varying from two to forty pounds per ton, and are then allowed to stand for a week or more. They are then run through a pulverizer into the hopper, from whence they are carried in trucks to the vats. The vats are twenty feet by seven feet, with eighteen-inch false bottoms made of stone. The sand is dumped on the top of this. The Day Dawn Company has ten vats of sixty tons each. Two are filled every day. On this sand is run a strong solution, varying from 0.35 to 0.5 per cent, and sometimes as high as 0.68 per cent. A sample of the ore is always subjected to preliminary treatment with cyanide solutions to determine the proper strength. The solution remains in contact for twenty-four hours, and is then tapped off into a sump. After this a weaker solution is run on and allowed to stand for three days. After this is drawn off, the sand is washed with water. Before the solution is run into the extractor box a test is made to find out if it is strong enough to precipitate the gold. After the solution is passed through the boxes, the zinc is taken out and placed on a sieve and washed by hand to get off the gold pulp, and the zinc returned to the boxes. The gold slime is placed in a filter with sand and stone, and that remaining on the top is put into a furnace and roasted, then mixed with sand and borax and smelted in a plumbago crucible, poured out into the iron mould, and finally roasted to get rid of the zinc oxide. Concentrates are never treated with tailings. Mr. W. A. Dixon, in discussing the same question, calls attention to the advantage of the weak solutions, the strong solution dissolving too much base metal, the base metals generally being in a coarser state than the gold. The selective action of the cyanide really depends upon the amount of surface of the metal exposed. If copper were finely divided, the cyanide would probably prefer this to the gold. The chemical action with the base metal compounds does not require oxygen, as is required with gold. Sulphide of iron, arsenical pyrites, sulphide of zinc and galena are not acted upon by cyanide of potassium. With copper ores, the cyanide dissolves too much copper to make the process useful. The effect of acid on the potassium cyanide gives essentially hydrocyanic acid. The use of lime prevents this. No substance is known which, in solution in water, will set free cyanogen gas as a gas in water, nor have experiments shown that cyanogen gas itself will dissolve gold. Experiments made to determine this last fact were made on Mount Morgan ores and others. The samples were ground and treated with cyanogen gas dissolved in water for twenty hours.—*Mining and Scientific Press* (San Francisco), September 27.

The Electric Motor in Rolling Mills.

At a meeting of the Engineers' Society, Mr. S. S. Wales presented an interesting paper on the use of motors in rolling mills. It is not quite ten years since the first systematic attempt was made to utilize the electric motor in rolling-mill work, yet it has almost entirely superseded the small hoisting engine in many places, and has rendered possible some classes of work which, if accomplished by steam, would require an outfit so cumbersome as to be almost prohibitory. One of the most notable applications of electric motors is to the overhead traveling crane which is used for handling materials of all kinds. The next application of importance is the horizontal charging machine, which is used to charge open-hearth furnaces and in hauling large slabs and blooms to and from the horizontal heating furnaces. Another large field of application is on the roller table. Here the adaptability of the motor depends not so much on its lightness as on the absence of long steam pipes, which act as condensers, and the complication of reversing levers. The fact that a motor will run with even an injurious overload, coupled with a general misconception of the manufacturer's rating, has resulted in the general application of motors much too small for their work. Competition has caused most manufacturers to underestimate the size of the motor required for the work; and although this can certainly do the work at the acceptance test of the machine, it may break down in less than two weeks of factory operation. Motors for mill use may be of any type, but at the present time no motor has such a diversified application as the series tramway motor, its claim to recognition being the powerful starting effort, its complete mechanical protection from external injury, and the fact that it is a standard article turned out in large numbers. Its drawbacks are its speed at light loads, and its lack of ventilation. The open type of motor has the advantage of easy access for inspection or cleaning, but offers no protection from injury due to foreign substances. The author then considers methods of determining the proper size of motor for such work as is ordinarily met with in mill use. As in a general crane specification the actual weights of material and gear reduction are not known, some assumptions have to be made. The electric crane is divided into three general parts—bridge, trolley and hoist. The author then gives a table showing the working load of cranes in tons, the weight of the bridge alone, in tons, and the weight of the trolley alone in tons with different length of span, and a formula is given by which the horsepower will be found, assuming any of the

above conditions. It is advised, however, that a motor fifty per cent larger than found in this way be installed, to prevent overworking and to allow for higher room temperatures. The power required by roller tables varies greatly, as they are subject to tight bearings and lack of oil. A formula is given for finding the size of a suitable motor for this class of work. In this case also it is advisable to use a motor fifty per cent larger than that theoretically required.—*Electrical Engineer* (London), October 4.

Distribution of Electrical Energy in the Department of the Aude (France).

This is a description of the most important hydroelectric installation in France, if not the most important high-tension system in Europe. M. Estrade, the director of the Société Méridionale de Transport de Force, conceived the idea and has put it into operation. The distributing network covers a country having 150,000 inhabitants. The transmission line is seventy kilometres in length from the central station at Corbrieres to Fabrezan, the centre of distribution. From this latter point three lines from thirty to thirty-five kilometres in length branch to secondary centres of distribution. The tension selected is 20,000 volts at fifty cycles, and the output of the plant is 1,600 kilowatts. The canal from the dam is 5,500 metres. At the generating station a fall of 101 metres is available. In the generating station are four groups, each of 800 horse-power. The turbines have a speed of 300 revolutions per minute and are of the Pelton type, placed three and one-half metres above the level of the tail-race. A draught tube enables part of this fall to be utilized. The alternators are attached directly to the turbines by means of flexible couplings, and are made by the Alioth Company. Each has an output of 700 kilowatts with a power-factor of unity, or with 540 kilowatts a power-factor of 0.8. The tension is 2,900 volts. A low-tension switchboard is provided, and all the generators are operated in parallel. After leaving the bus-bars, the current passes through step-up transformers, the pressure being raised to 20,000 volts. There are twelve of these single-phase transformers, each of 200 kilowatts, air cooled. The current passes through a high-tension switchboard, where the switches are operated by compressed air. The line consists of three cables thirty-eight square millimetres in section. Before starting the operation of the plant, each line was tested to the earth at 22,000 volts, and a tension of 30,000 volts was applied between the wires for three hours. At the receiving station the voltage is lowered to 125 for the immediate locality, and to 5,000 volts for outlying districts. Where the 20,000-volt lines cross the railways special precautions have been taken, and at these points paper-insulated, lead-covered cables are carried over the road. The substations in each town contain a transformer for lowering the potential from 5,000 volts to 125 volts. At the towns of Carcassonne and Narbonne, where there already existed a three-wire, direct-current distributing system, motor-generator sets have been installed. These consist of two synchronous motors of 225 horse-power, 500 volts, coupled directly to continuous-current generators, delivering current at 300 volts. At other points in the department three-phase induction motors are used. By arrangement with the local authorities, the expense of local construction has been carried out by these, so that the company has only been required to bear the expense of the generating station and high-tension transmission lines. In consideration of this, municipal lighting is furnished free at the rate of twenty-five sixteen-candle-power incandescent lamps per 1,000 inhabitants. For other lighting, sixteen-candle-power lamps are furnished at the rate of thirty-two francs per year. The present demand on the station is for 1,100 kilowatts, this being thirty-four amperes at a tension of 1,920 volts. During the winter months 1,600 kilowatts can be furnished by operating the alternators in parallel. The operation of the plant has been very successful, and it is possible that the distance of distribution will be increased by raising the pressure to 40,000 or 50,000 volts.—*L'Industrie Electrique* (Paris), September 25.

Traction of Road Vehicles.

This communication made at the recent Belfast meeting of the British Association covers work done by the committee on the resistance of road vehicles to traction. The report was prepared by Professor H. S. Hele-Shaw and Mr. Girr. A list of the authorities referred to is given, covering work done from 1832 to 1902. The following is a description of the apparatus used by this committee in their investigations. A frame was constructed in which can be mounted, either with or without springs, a series of wheels varying in size from eighteen inches to five feet in diameter. This frame can be loaded by steps up to a total weight of one ton. It is attached to any suitable vehicle, upon which is mounted a recording dynamometer of special construction. A universal joint is inserted between the frame and the car, so that the former is free to move in two directions. The tractive force required to draw this experimental wheel is transmitted through a system of levers to a small ram filled with water or other liquid, which records the pressure by means of a Bourdon gauge. The tractive force will vary from ten pounds with light loads and good roads up to 500 pounds under adverse circumstances. With this fact in view, an instrument of wide range was required. This has been secured by the use of four leverages, any of which may be used to transmit the effort to the ram. The method of operating the dynamometer and performing a trial is as follows: The cylinder of the ram is filled with water and a leverage suitable for the trial is chosen. After adjustments are satisfactory, a run is made to some given point over a piece of road whose surface is of the desired type, a return run being made over the same road back to the starting point. Taking the mean value of the total journey out and return, the effect of inclines is eliminated. The load is increased and the route traversed again. Other tests are made with the same wheel and load, but varying the speed, and still additional tests have been made, using wheels of different makes. The first experiments were made in August with a light lurry wheel forty inches in diameter, having a three-inch iron tire, slightly rounded in section. The wheel was mounted on a pair of springs, with three-foot two-inch centres. Three runs were made, with loads of three and one-half hundredweight, five and one-half hundredweight and eight and one-half hundredweight, respectively, the velocities ranging from six to fourteen miles per hour. The route was over a level road, paved with sets six inches by three inches, with a one-inch gap, and had a regular, but fairly rough, surface. Results show a tractive effort in pounds per ton, increasing from 66.7 at speeds of five miles an hour to 148.5 at a speed of thirteen miles per hour. The tractive effort rises considerably with a power of the velocity. Another set of experiments was made with a pneumatic-tired wheel, twenty-four inches in diameter, with a two and three-eighth-inch tire. This run was over a level stretch of macadam road. The surface was in fairly good condition, slightly wet in places. The results show a tractive effort per ton which varies slightly with changes in velocity, being 133.5 at 6.65 miles per hour, and 138.4 at 14.5 miles per hour. These results agree with observations made by Michelin, who showed that with a pneumatic tire on a macadam road the tractive effort increased but slightly with the velocity. During the ensuing year experiments will be conducted to determine the relation between the tractive effort and the load, diameter of wheel, width and section of tire, hardness of tire, effect of springs and velocity for every type of road under all circumstances, and any other relations that may be suggested during the progress of the work.—*Engineering* (London), October 3.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Machine Tool Motors.

The accompanying illustrations show the construction and some typical applications of motors to electric driving. The field frames are cast from a fine grade of soft steel of a special mixture, having a high magnetic permeability. The quality of the metal, it is claimed by the manufacturer, is closely inspected by chemical analysis, this being the only method by which uniformity of grade can be assured. As may be seen from the illustrations, the frames are without joints of any kind, ensuring an ideal and perfect magnetic circuit. The castings are smooth and true to pattern, and free from porous or spongy defects.

The field coils are accurately formed of perfectly insulated copper wire, wound evenly and compactly by automatic machinery, securing the maximum ampere-turns without bulkiness. Insulation of the coils, as well as protection from mechanical injury, has been carefully worked out, and these coils are claimed to be practically impervious to water, moisture or oil, and can not be mechanically injured unless intentionally, this high class of insulation also rendering them proof against damage by sudden fluctuations of voltage.

The armatures are of the usual iron-clad type, the core being built up of thin annealed soft steel discs, each disc being insulated on both sides. When assembled, they are highly compressed and keyed on to a spider designed to allow perfect ventilation.

The commutator segments are forged from pure copper, uniform in density and having the grain or flow in the direction of length. No artificial or compound insulation is used, nothing but the best mica being depended upon for this work. The sheets are carefully selected and graded according to thickness and perfection. A number sufficient for the insulation between two segments are assembled and gauged with a micrometer. These sheets of mica are used without varnish, so that there can be no shrinking and consequent loosening of the commutator. The high quality and fibre of the mica used prevent chipping out or scaling off between the segments. The material of the commutator segments ensures a smooth, durable surface.

The brush-holders and brushes are very simple and consist of few parts, offering a ready and equal adjustment of each brush. Any brush can be easily and conveniently removed and replaced while the machine is in operation. The area of brush surface is in all cases ample to the amount of current to be carried. The use of tension springs for carrying current is entirely avoided. The frame of the holder is made of aluminum and the weight carefully distributed, so that there is no tendency to chatter. The armature coils are form wound from wire or bar copper, according to the size of the machine. Each coil is in every instance made from a single length of copper, and enclosed in an insulating cell. The slots of the armature core are also lined with a layer of insulating material before the bars are laid in place, so that there is absolutely no chance of a ground or fault developing at this point.

A characteristic feature of these motors, and one to which much study and work have been devoted, is the bearings. These are either of bronze or babbitt metal, according to the size of the machines. The arrangement is such that in no event is it possible for the armature to drop against the pole-pieces and become damaged. All the bearings are provided with generously large oil wells and automatic oiling rings, and the danger of a hot box is a remote one, unless there is

FIG. 1.—ONE-PIECE STEEL FRAME.

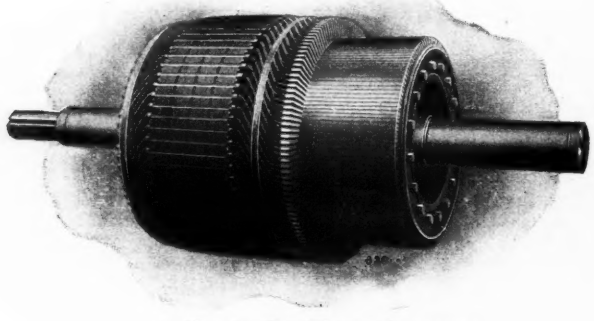


FIG. 2.—BAR-WOUND ARMATURE.

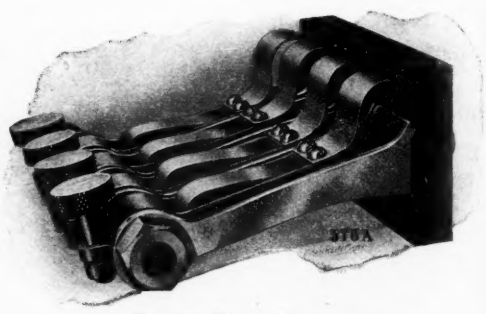


FIG. 3.—BRUSH-HOLDERS.

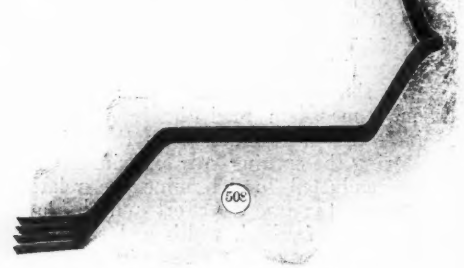


FIG. 4.—BAR-WOUND COILS.

great neglect. Each bearing is spherically seated, making it self-adjusting and self-aligning. When not intended for gear driving or direct-connection, these motors are fitted with an improved belt adjusting device. A few turns of the adjusting screw with a wrench will move the motor forward or back, but with no possibility of becoming skewed or out of centre, or being tilted off.

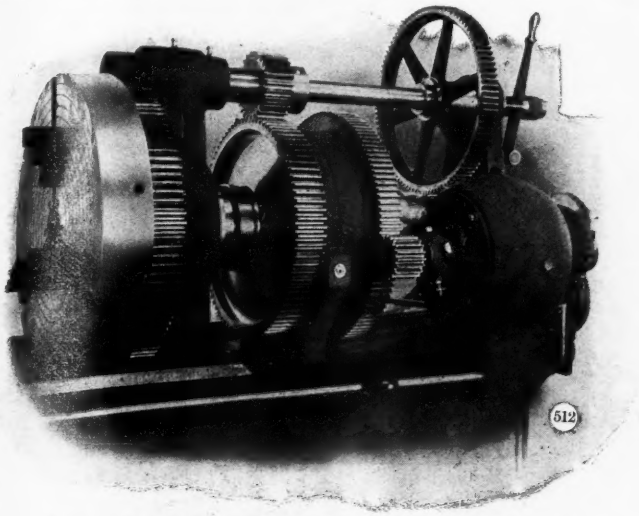


FIG. 5.—DIRECT-CURRENT MOTOR DRIVING TURRET LATHE.

These motors are particularly suited for work in many places where overhead shafting and belt driving are almost out of the question. They may b either belted, direct-connected or geared to the machine to be driven, and the compact and symmetrical design is of great value where it is desired to combine the motor and the driven machine so that no additional floor space is required. The construction of the bronze bearings and automatic oiling rings is such that the motor can be operated on the floor, ceiling or side wall with equal facility, the change from one position to the other being easily and quickly made by simply transposing one screw and the oil cock on the bearings. No change is necessary in the field terminals.

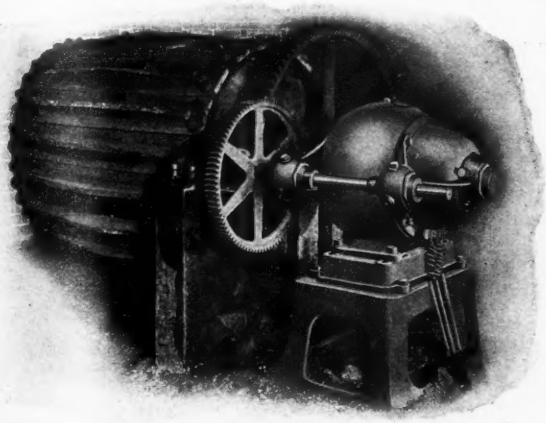


FIG. 8.—BACK-GEARED DUST-PROOF MOTOR, DRIVING FOUNDRY RATTLER.

Where conditions require that the shaft of the motor be geared to the driving shaft with or without speed reduction, several difficulties present themselves. There must be an absolutely true alignment and unvarying relationship of shaft and gears in order to ensure frictionless, noiseless and easy running. The manufacturer claims to have met all the requirements and obviated the difficulty with a special back-geared motor, and this has met with great favor by the machine tool trade as a substantial and simple method of speed reduction in the application of electric motors to driving tools. This is well shown in Fig. 7.

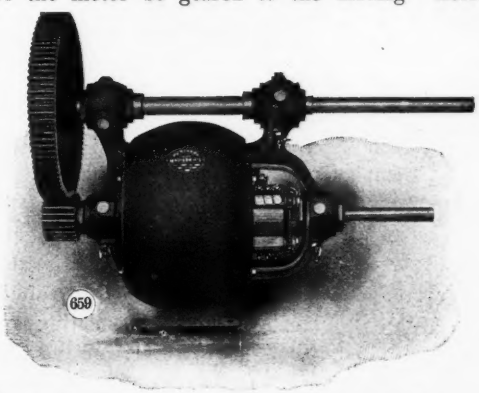


FIG. 7.—BACK-GEARED MOTOR, WITH EXTENDED SHAFTS

Another practical application of a back-geared motor is illustrated in Fig. 8, showing a dust-proof motor driving a foundry rattler. This part of the equipment of large plants is very often neglected as being of minor importance, but it has been demonstrated that the application of a motor to this branch of machine work has been very economical and secures a maximum output with a minimum of labor.

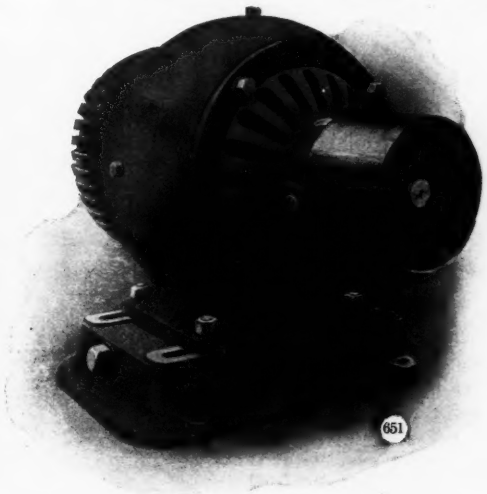


FIG. 6.—ENCLOSED TYPE, SPHERICAL MULTIPOLAR MOTOR.

It has been found in many instances not only more convenient, but more economical and desirable, to operate a driven machine with a vertical shaft, avoiding in this manner the use of double gears, universal joints or quarter belts.

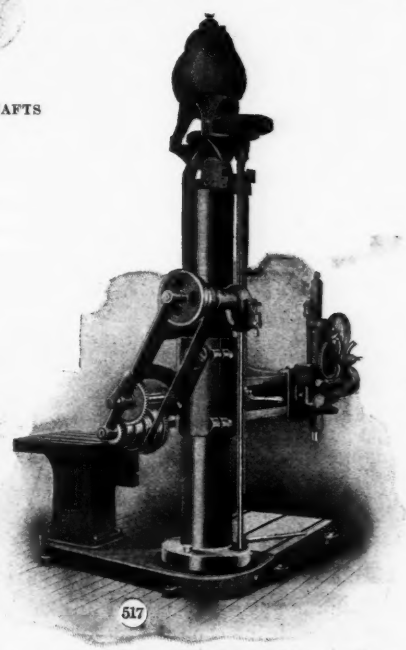


FIG. 9.—VERTICAL DUST-PROOF MOTOR, DRIVING RADIAL DRILL.

Where this has been the case, the vertical motor has been gladly welcomed, and has in almost every instance proved a decided success. Fig. 9 shows a vertical dust-proof motor driving a radial drill. This drill is of the usual sight-feed type, the connection between the cup and bearings being such that while a positive and uniform supply of oil is assured there is no leakage or flying particles. This arrangement secures clean and cool running bearings, without a tendency to attract dust or gritty particles. This combination makes one of the neatest applications of electric motors to machine tool practice.

Fig. 10 shows a universal motor driving an ordinary lift elevator. While this motor is constructed very much the same as the standard spherical type, it has some features which have contributed greatly to its success in this application. The field frame is cast with a circumferent ring, and this is machined in accurate alignment with the armature shaft, thus enabling the motor to be merged into the general design of any apparatus without interfering with or destroying the symmetry desired by the machinery designer.

Fig. 11 shows an electric emery grinder. This is a self-contained outfit, and the wiring and starting box and accessories are enclosed and protected from possible injury in a hollow pedestal. These are equipped with starting and regulating rheostats, so that the speed may be instantly regulated to suit the work, and are so arranged that they are ready for immediate use upon connection with the circuit, there being no casting about for proper location of belts and hangers.

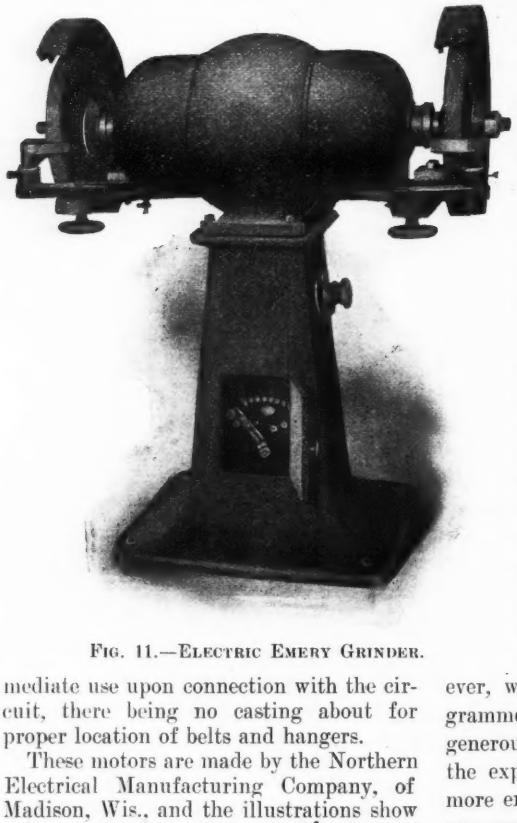


FIG. 11.—ELECTRIC EMERY GRINDER.

These motors are made by the Northern Electrical Manufacturing Company, of Madison, Wis., and the illustrations show only a very few of the applications of these motors to machine tool service.

Telephone Manufacturers Celebrate.

On Saturday evening, October 11, a most enjoyable luncheon and dancing party was given at the Stromberg-Carlson Telephone Manufacturing Company's factory. The entertainment was arranged by the employés of the insulating and winding department, and tendered to the employés of other departments throughout the building. The affair was in the nature of a farewell party, and due to the fact that during the week of October 13 many of the employés of the insulating and winding department of the Chicago factory go to Rochester, N. Y., where in future the insulated wire and cable product will be manufactured at the Stromberg-Carlson company's Rochester plant.

About a year ago a restaurant service was provided for the young women employed by the company, and since that time luncheon has been served daily in this department. It has been in part self-sustaining, and it was the surplus in the treasury which the young women proposed to use toward defraying the expenses of the entertainment. Mr. A. L. Stromberg, however, was heartily interested in the programme from the beginning, and very generously defrayed the greater part of the expense in order to make the affair more enjoyable. As a result the occasion was one which will be long remembered most pleasantly by all. It was midnight when the dancing ceased, to the strains of "Home Sweet Home."

The seventh floor, east side, was cleared in the afternoon, and within a few hours complete preparations were made to accommodate the company. Additional electric lights were placed, tables prepared, and seats arranged for 100 couples. Three times these tables were filled, and much credit is due the ladies who had the service in charge. Music was furnished by Bredfield's orchestra, consisting of seven pieces. Vocal solos were rendered by Mr. Hedman and Miss Frobenius. Short speeches were made by Messrs. Stromberg, Stiger, Nate, Mahon, Runzel, Hedman and others.

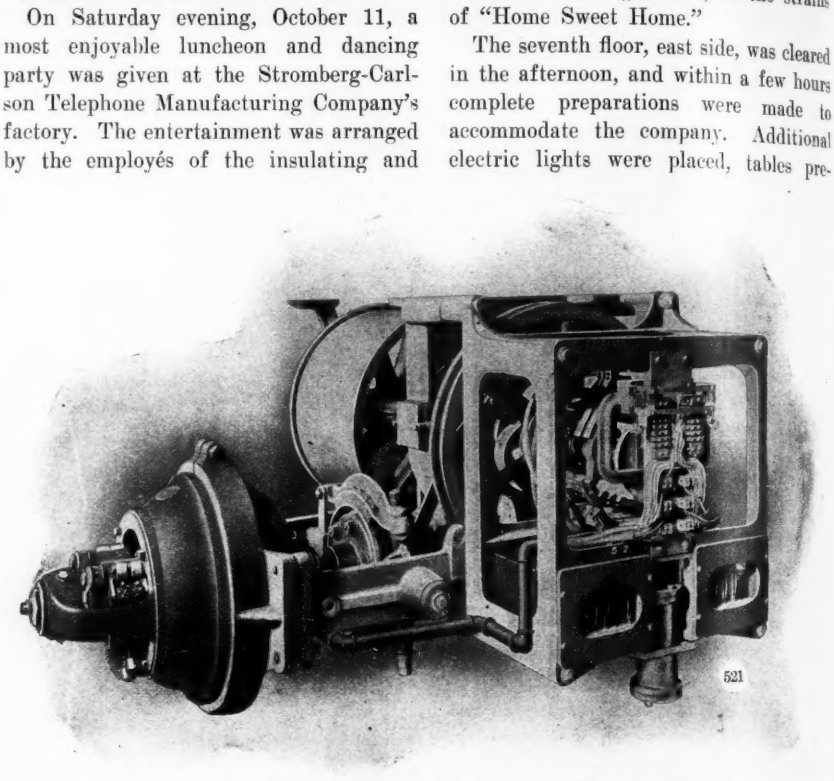


FIG. 10.—UNIVERSAL MOTOR, DRIVING EATON & PRINCE ELEVATOR.

Mr. Stromberg's speech was particularly happy, in that it expressed the sincerity of his interest and gratified pride at the faithfulness of his employés, and the manner in which the business has been carried to its present successful issue.

Over 400 were present, of which the following is a partial list. Officers and representatives: A. L. Stromberg, C. W. Stiger, A. J. Rousseau, J. J. Nate, T. R. Finnucane, A. J. Mahon, W. H. Durrant, C. E. Knickerbocker, F. L. Middleton, Carl Schafer, A. A. Anderson, Joe Carlson, W. H. Gray, W. L. Roberts, C. M. Hedman, J. Peterson, William Schuber, William Runzel, E. W. Anderson, A. O. Stigberg, T. C. Troy, Frank Lind, J. N. Woods, W. Ratke, S. E. Wallace, J. S. Troy, C. B. Arbeen, J. P. Lillig, N. Engstrom, A. Peterson, John Meinema, James Krabec, J. Kaiser, A. Hendrickson, A. B. Blidd.

Employés: Messrs. Backstrom, John

Johnson, Ryan, Kuepper, Thorsell, Schneberg, J. W. Johnson, Griffith, Lillig, Briggs, Knudsen, Reinke, Marriner, Bowles, Engstrom, Carruthers, Larson, Garney, C. Anderson, Dolan, A. Johnson, L. St. Pierre, L. B. St. Pierre, Willet, Donnelly, Green, Cram, Parker, Shroder, Newberg, Kviteck, Shotts, Rudland, Rickter, Smith, Peter Johnson, Miles, Ben Anderson, Larson, Robert Larson, Cederleaf, Lindell, Erickson, Walin, James Bowles, Reinhard Johnson, Wirlin, Victor Carlson, Telefson, Charles Carlson Abbe, Edward Johnson, Samlow, C. F. Johnson, Glendenning, Leopold, Denny, Lundine, N. Anderson, Olson, Theodore Anderson, Gustafson, Bain, Alexander Bain, Borowinski, Wolf, J. Carlson, A. Anderson, Paul Hirch, Richter, Stull, J. Carlson, M. J. Thomas and M. Devito, Mrs. Senn, Mrs. Casle, Misses Durrant, Hanson, Laiger, Sullivan, Murray, Akyroid, Hendrickson, Straka, Cunnalley, Winner, Kirk, Shillo, Soucke, Swanson, Troy, Logan, Amstead, Faudrop, Lottie Petterson, Dureer, Taylor, Alice Nelson, Nagorsen, Neitz, Armer, Becker, Mae Anderson, Spiak, McKinney, Lizzie Fister, Kittie Murphy, Lizzie Daker, Radora, Mame Fister, Rena Nelson, Voight, Roberts, Brode, Fay, Dwyer, Almsted, Anna Anderson, Dillon, Patra Peterson, Epstein, O'Neill, Minnie Roberts, Desparroes, George Rose Anderson, Mae Peterson, Klinger, Murray, Webb, Gioss, Rapke, Straube, Smithson, Kallal, Hansen, Buntrock, Coates, Bieljewske, Behnke, Kober, Kent, Madog, Eilers, Fraedrick, Hattie Fraedrick, Kallal, Powers, Shwekann, Inwood, Florence Nelson, McKeon, Meyer, Hanna Anderson, Beason, Casle, Bennecke, Teal and Pettee.

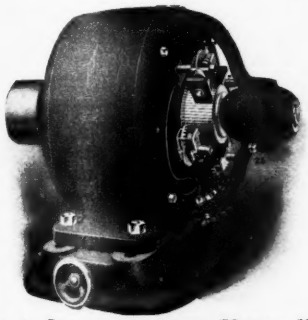


FIG. 1.—INVERTIBLE STEEL MOTOR, NEW TYPE.

Oil for fuel purposes has the following chemical composition: Carbon, 88 per cent; hydrogen, 10.75 per cent; oxygen, 1.25 per cent. The two other impurities present in the mass are water and sulphur.

New Type Invertible Motors.

The Akron Electrical Manufacturing Company, of Akron, Ohio, has added to its already extensive line of direct-current machinery a new class of apparatus in its invertible motors, in sizes from one-

FIG. 2.—DETAILS OF THE BEARINGS.

eighth to thirty horse-power. The open motor shown in Fig. 1 gives a good idea of the appearance and construction of this apparatus. There are many new features

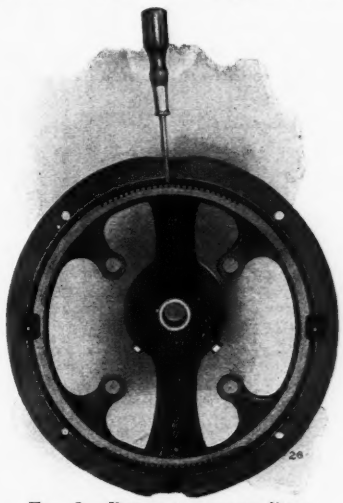


FIG. 3.—BRUSH-CARRYING RING.

which the company feels make these machines distinctive from the ordinary direct-current motor. The bearings are so constructed as to enable the motor to be

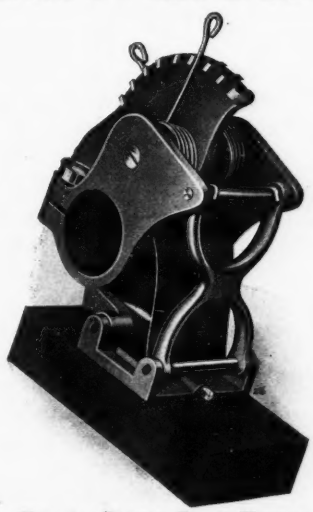


FIG. 4.—RADIAL BRUSH-HOLDER.

operated on the floor, wall or ceiling, without any change in the bearing sleeve or oiling mechanism, it being a matter of indifference, so far as the operation of the machine is concerned, in what position it is operated. This will, no doubt, be greatly appreciated under special conditions, owing to the fact that it is very often necessary to readjust the bearings to suit the different planes of operation. The illustration of the bearing (Fig. 2) shows very plainly the special features. The groove in which the ring operates extends entirely around the shaft, and the oiling ring itself is constructed with a groove upon its inner circumference, which enables it to supply a large flow of oil to the journal. These bearings are made absolutely interchangeable. The commutator end bearing can be used in the pulley end of the machine, and *vice versa,* or the bearing can be removed and turned end over end for the same side of the machine.

The brush-holders and brush-supporting mechanism are carried from the frame of the machine, enabling every brush to

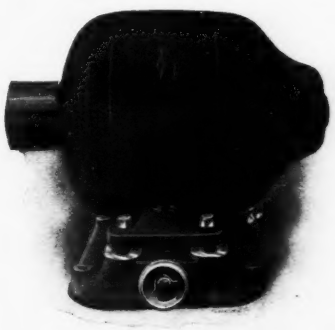


FIG. 5.—ENCLOSED MOTOR.

be removed without disturbing any other operation of the machine. The brush-holders proper are an original type having radial action and a clamping contact from carbon brush to stud. The construction of these holders also enables any individual brush to be adjusted in regard to spacing on the commutator regardless of the other brushes. These brush-holders are also provided with a stop to prevent the contact of the metal parts of the holder with the commutator surface.

The supporting ring which carries the brush studs is shown in Fig. 3, and is a novel and one of the patented features of these machines. This supporting ring is provided with a section of gear teeth cut in its periphery, which enables it to be adjusted by a screw-driver inserted in the top bonnet to any desired position. The illustration shows the screw-driver in position when actuating the brush-adjusting mechanism. When adjusted to its proper position, the brush-adjusting ring is clamped through lugs which engage it sidewise. This method of clamping prevents alteration of the brush adjustment

through the spring of the starting ring by the clamping screws.

Fig. 4 is a good illustration of the patented radial brush-holder. All current is carried through clamped contacts, and none is carried by tension springs.

These motors are also built enclosed and semi-enclosed, Fig. 5 showing a semi-enclosed motor. The enclosing covers on this machine are a unique and valuable advance in this line. They are formed of sheet metal, and are made to the required shape by being spun over chucks, which gives them the exact shape required and enables them to be fitted so closely as to exclude dust and dirt in the most thorough manner. The covers being made of sheet metal enables the heat to be radiated from a completely enclosed motor very effectively. These covers give an extremely smooth and uniform appearance to the machine on which they are used, and any type of open motor can be fitted with enclosing covers at the proper rating.

Trolley Trip at Railway Convention.

During the recent convention of the American Street Railway Association at Detroit, the Crocker-Wheeler Company gave a trolley party for the delegates and their visitors. The trip was over the line of the Flint division of the Detroit United Railway to the power-house at Rochester, twenty-eight miles from the city. This plant furnishes power for the entire division, nearly seventy-five miles of track, and includes a 400-kilowatt generator, two 200-kilowatt units and a booster set, connected in series with the line, capable of giving 150 volts pressure and 400 amperes. This enables the line voltage to be raised to 800 volts during times of heavy load. All the foregoing apparatus is of Crocker-Wheeler make. In addition, there is a rotary converter with transformers, raising one feeder pressure to 11,000 volts, which, transmitted to the Flint end of the line, is reduced at a substation to proper voltage direct current. The plant is very heavily loaded, the generators frequently carrying overloads of 100 per cent and often being compelled to stand for a considerable length of time overloads as high as seventy-five per cent. The plant is an interesting one in showing conditions encountered in long-distance interurban work, and the methods at present in use for meeting these requirements.

The company's interests were looked after during the trip by Mr. Putnam A. Bates, assistant secretary, and Mr. C. W. Startsman, of the Ampere office of the company, Managers F. B. Degrees, Julian Roe, W. H. Wissing and W. F. Sullivan, of the New York, Chicago, St. Louis and Cleveland offices, respectively, and W. J. Hartwig, local representative for the company in Detroit.

About 100 of the delegates availed themselves of the opportunity of making this inspection, and after refreshments had been served at the power-house, cars were again boarded and return trip made to the city in very fast time. The roadbed is good; there are few heavy grades, and the line is one of the best equipped of all those radiating from the city of Detroit.

Mr. Henry S. Parmelee.

The death recently noted in these columns of Henry S. Parmelee, of New Haven, on his schooner yacht, Alert, at Bay Ridge, N. Y., was a distinct loss to

MR. HENRY S. PARMELEE.

New Haven, with which community he was prominently identified in many ways, and the street railway interests of the country to which he had contributed much, especially in the way of operative method and mechanical equipment.

Mr. Parmelee was fifty-eight years old, and was born in an Ohio town where his parents were temporarily stopping. His boyhood days were spent chiefly in New Haven, New York and Edinburgh, Scotland. He was the son of Spencer T. Parmelee, who was for many years one of New Haven's leading business men, and who died in 1875.

Mr. Parmelee came into prominence by his connection with the Fairhaven & Westville Railroad Company. He had been a member of the board of directors since 1878, his father also for some years being a director, and upon the death of Hoadley B. Ives was elected president, March 28, 1884. With the change in the management of the road, and with Mr. Parmelee in control, a complete revolution in the methods of street railway transportation took place. The old car lines soon gave way to the introduction of electricity for motive power. This improvement was followed by steps to consolidate all the street car lines in the city under one management. Through his efforts the Fairhaven road acquired control of the New Haven & Hamden, or the Old Huckleberry road, as it used to be called. Apart from his duties as the head of his road, President Parmelee was personally very active in directing the affairs in various branches. While the street railway system was undergoing the change and the work going forward for the transfer from horse cars to electric cars, he personally superintended the work of equipping the road for electricity. He was a man of inventive talent, and there are in use to-day in one department or another of the Fairhaven road many devices designed by him. Besides being interested in these railway enterprises, he was closely associated with many other industries. Mr. Parmelee is survived by a widow and three children—two daughters and one son, Henry F. Parmelee, who will succeed his father in the administrative duties in connection with the Parmelee interests.

American Institute of Electrical Engineers.

The following list of meetings and subjects to come in regular order before the American Institute of Electrical Engineers has been arranged by the proper committees. These meetings will be held at No. 12 West Thirty-first street, New York city, the session opening at 8.15 P. M.

October 24, 1902, "Photometry and Illumination"—"An Integrating Photometer for Glow Lamps and Sources of Like Intensity," by Charles P. Matthews; "Distributed Lighting," by Douglass Burnett; "Some Methods of Photometry as Applied to Incandescent Lamps," by J. T. Marshall.

November 21, 1902, "Electric Variable Speed Control."

December 19, 1902, "Braking and Traction Brakes."

January 23, 1903, "Telephone Exchanges."

February 27, 1903, "Railway Train Lighting."

March 27, 1903, "High-Tension Lines."

April 24, 1903, "Tendencies of Central Station Development."

May 19, 1903, "Induction Generators."

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

ELECTRICITY FOR DETROIT—Francis H. Clergue, of the Canadian Sault Ste. Marie installation, announces that plans have been made for supplying Detroit with electricity from the power plant at the falls. The idea is to carry the current by cables on towers. It is proposed to furnish 20,000 horse-power at first.

TRACTION CONSOLIDATION—The Dayton Eastern Consolidated Traction Company has been incorporated at Columbus, Ohio, for the purpose of consolidating all the traction roads west and southeast of Dayton, extending as far as Wilmington, Washington Court House, Xenia and other near-by towns. Some of the traction companies in this territory, it is claimed, have already entered the combination, while negotiations for the others are in progress. The distance to be covered is 130 miles. The stock is estimated at $3,500,000, and bonds to the same amount will be issued.

ELECTRIC CONCERNS TO MERGE—The sale of the Dallas ice factory and power company to a Kansas City man is believed to be another move toward the merging of all the electrical plants of Dallas, Tex., and many of those in the surrounding towns. Already a concern known as the Dallas Electric Corporation, and chartered in New Jersey with a capital stock of $8,500,000, is said to have absorbed the Dallas Electric Light and Power Company, the Standard Light and Power Company, the Rapid Transit Street Railway Company and the Consolidated Street Railway Company, with the ultimate intention of building a network of interurban lines within a radius of 120 miles of Dallas, which district has a population of over 1,000,000 inhabitants.

WIRELESS RAILWAY TELEGRAPHY—It is understood that on a special train on the Grand Trunk Railroad which passed recently through Montreal, with a large number of general passenger agents on board en route to Portland, Me., to attend the annual meeting of their association, an exhibition of wireless telegraphy was given, this being the first application of this discovery to railroad purposes. The despatcher was stationed at St. Dominique station—the receiving apparatus on the train moving at sixty miles per hour. Communication was first established eight miles from St. Dominique and continued uninterruptedly until the station had been left far behind. The experiment was conducted by a number of scientists, it is said, attached to McGill University, and is described as having been very successful.

AN ANGLO-BELGIAN TELEPHONE—An Anglo-Belgian telephone service will be inaugurated in about a month. The submarine cable stations are located at St. Margaret's Bay, near Dover, and at La Panne, a Belgian seaside resort. The work of laying the cable is completed, and the company is now placing aerial extensions in both England and Belgium. The cable is fifty-five and one-half miles in length and has two circuits. The total cost when completed will be about $386,000, to be shared equally by England and Belgium. Belgium will communicate with England from the cities of Brussels and Antwerp only. If communications are numerous and the new line is profitable to the government, the service will be extended to other cities. The rate of communication has been fixed at about $2 for three minutes' conversation.

PERSONAL MENTION.

MR. LAMAR LYNDON, the consulting electrical engineer, New York, has recovered from a severe illness and is again at his office in the Park Row Building.

MR. WILLIAM STARK SMITH, secretary and treasurer of the Browning Manufacturing Company, Milwaukee, Wis., was a visitor at Denver Col., two days last week.

MR. F. R. BACON, president of the Cutler-Hammer Manufacturing Company, came to New York city last week to meet friends arriving on an inbound steamer from Europe.

MR. H. O. SWOBODA, formerly secretary and treasurer of the Falcon Electric Manufacturing Company, of New York, resigned that position on October 15 and will enter other business.

MR. H. T. BIRCH, JR., secretary and treasurer of the Haines & Noyes Company, telephone manufacturer, Chicago, Ill., was at the Waldorf-Astoria, New York city, for several days last week.

MR. H. M. SALMONY, 95 Mortimer street, London, who is desirous of representing the European interests of American manufacturers of electrical machinery, will arrive shortly in the United States.

MR. IVAR MOLTKE-HANSEN, Charlottenburg, Germany, who recently came to the United States to become acquainted with the electrochemical industries here, has become associated with the American Smelting and Refining Company, at Perth Amboy, N. J.

MR. A. W. McLAMONT, of the Federal Electric Company, New York city, has been chosen as consulting engineer in a large traction system about to be laid down in Monterey, Mexico. Mr. McLamont is now on his way to Monterey, with representatives of the Baltimore firm which is contracting to do the work.

PROFESSOR REGINALD A. FESSENDEN, who has for some time been connected with the government as special expert, has resigned this position and will hereafter devote all his efforts to the establishing of a purely American system of wireless telegraphy, making his headquarters in the neighborhood of Norfolk, Va.

MR. ALEXANDER McKENZIE, formerly of the Toronto Railway Company, has been appointed vice-president and general manager of the Sao Paulo Tramway, Light and Power Company, of Sao Paulo, Brazil. This system is now being extended and equipped with American machinery. Mr. McKenzie has sailed for Brazil.

MR. D. CLARENCE DURLAND, who is well known in the electrical field, has been elected second vice-president of the Sprague Electric Company. For the past three years he has been assistant general manager of the Sprague company and his promotion is evidence of his engineering and executive abilities which he has combined to a marked degree.

MR. W. J. HAMMER, the electrical engineer, New York city, returned recently from a four months' visit to Europe. Mr. Hammer has been making a study of the latest electrical and engineering developments in England, Norway, Sweden, Switzerland, Belgium, France, Denmark and Italy, spending some time inspecting the Valtellina three-phase railway in Italy.

MR. ALBERT CRANE, formerly first assistant chief engineer of the Lake Superior Power Company, at Sault Ste. Marie, has accepted a position as one of the assistant chief engineers of the Chicago Sanitary District. He is an expert in hydraulic engineering and will be placed in charge of the water-power department on the drainage canal at Lockport and Joliet, Ill.

MR. GEORGE G. BLACKWELL, of George G. Blackwell, Sons & Company, Liverpool, England, is now in Canada and will soon visit the United States, making a short stay in Buffalo, Cleveland, Pittsburg, Philadelphia and New York. Mr. Blackwell's visit to this country is made for the purpose of closing a number of substantial deals concerning his company's specialties.

MR. FREDERICK L. HUTCHINSON, of the Christensen Engineering Company, of Milwaukee, Wis., was a New York and Boston visitor last week. The Christensen company which recently began the manufacture of electrical machinery for lighting, power and railway service, both alternating and direct, will establish headquarters for this branch of its business in New York and Boston.

COLONEL ALLAN C. BAKEWELL, who was recently elected president of the Sprague Electric Company, has long been indentified with the electrical industry, and has won many friends through his executive ability and business methods. He was vice-president and general manager of the old Interior Conduit and Insulation Company which was absorbed by the Sprague Electric Company some years ago. Previous to his present office he was for three years second vice-president and general manager of the Sprague company.

ELECTRICAL SECURITIES.

Speculative sentiment has shown a decided change for the better since the latter part of last week. This is undoubtedly the result of forced liquidation in securities, and the end was thought to have been reached in last Monday's sharp break. The two important developments which have completely determined market conditions for some time—that is, the coal strike and the money stringency—winding up practically at the same time brought about this better condition as a natural result of professional faith in the integrity of market conditions generally. The chief development in the monetary situation was the further aid offered to the money market through the purchase of bonds by the government. This comes most opportunely for the bull speculators who are attempting a resumption of the manipulative tactics of the summer and early fall. These are by far the most effective of the government relief measures, and all this will become immediately available to the money market. The effects can not be other than highly beneficial, and financial circles look forward to comparatively easy money rates during the coming winter. Another feature of the money situation was the early weakness in sterling, which brought out some talk of possible gold imports. With the relaxation in money, however, sterling developed unexpected firmness, and it has become evident that gold imports in any volume can only be brought about by a continuation of money tightness, of which there is no present possibility.

The government statistics for September show an excess of exports of $27,792,000, as against an excess last year of $40,163,000, and for the nine months an excess of $235,218,000, as against $399,841,000 for the same period last year. The total exports of merchandise were larger than any month but one in the past year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 18.

New York:	Closing.
Brooklyn Rapid Transit	64¼
Consolidated Gas	220
General Electric	188½
Manhattan Elevated	135¾
Kings County Electric	204
Metropolitan Street Railway	141½
New York & New Jersey Telephone	156
Westinghouse Manufacturing Company	217

Kings County Electric closed at 204 bid, offered at 210. Following the general upwardness of the market, the electrical securities all made substantial gains, and on considerable business the points in advance were held steadily throughout the week.

Boston:	Closing.
American Telephone and Telegraph	167¼
Edison Electric	267½
Massachusetts Electric preferred	94½
New England Telephone	137½
Western Telephone and Telegraph	100½

The local market was very busy and the electrical securities made a very good showing. Massachusetts Electric gained ½ rising to 37½, and American Telephone ½ to 167½. The annual report of the Edison Electric Illuminating Company for the year ended June 30, 1902, shows the total assets to be $12,989,005. For 1901 the total assets were $6,286,487. The number of incandescent lamps connected for 1902 is 442,034, arc lamps 8,548, motors 19,130 horse-power. During the year, the purchase of the Boston Electric Light Company was completed. The affairs of the Boston company came under the management of the Edison company in October of last year. The acquisition of the Suburban Light and Power Company was also decided upon during the year, and all the property and assets of that company were purchased for cash and its affairs turned over to the Edison company in September of last year. Property was purchased in Central Square, East Boston, and in Roxbury for two additional substations, and suburban offices were opened in East Boston, Dorchester and West Roxbury.

Philadelphia:	Closing.
Electric Company of America	9¾
Electric Storage Battery common	87½
Electric Storage Battery preferred	87
Philadelphia Electric	8⅞
Union Traction	47
United Gas Improvement Company	115¼

United Gas Improvement was the principal feature of the local stock market. On the closing day it opened strong at 114¾ and advanced to 115¼, closing at that price.

Soon after the incorporation of the Electric Storage Battery Company, in Philadelphia, a company was formed in England, under the name of the Chloride Electrical Storage Syndicate, Limited. This company acquired all the patents and improvements, past and future, of the Electric Storage Battery Company for the world, outside of the United States and Canada. The Electric Storage Battery Company, of Philadelphia, has now purchased control of the English company.

Chicago:	Closing.
Chicago Edison Light	107
Chicago Telephone	168
Metropolitan Elevated preferred	89⅞
National Carbon common	30
National Carbon preferred	100
Union Traction, common	18
Union Traction preferred	50

The National Carbon directors have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable November 15. The books will close November 5 and reopen November 19.

ELECTRIC LIGHTING.

BARABOO, WIS.—The Baraboo gas and electric light plant has been sold to Brown & Mayer, of Chicago. A new plant will be put in at a cost of about $50,000.

DECATUR, ILL.—Indiana capitalists have petitioned the city council for an electric lighting and heating plant in this city. It is expected that the franchise will be granted.

SALT LAKE CITY, UTAH—The Utah Light and Power Company has commenced work on its new central station, which will add about 3,000 horse-power to its present capacity.

DULUTH, MINN.—The Duluth General Electric Company is about to double the capacity of its plant at a cost of $250,000. It is expected that the new machinery will be installed within two weeks.

CANANDAIGUA, N. Y.—The village board of trustees has called a special meeting to determine whether or not a municipal electric lighting plant shall be built. If a municipal plant is decided upon, the village will be bonded for $50,000, and the construction of the plant begun at once.

STROUDSBURG, PA.—It is reported that a number of New York and Philadelphia capitalists have formed a company to utilize the power of McMichaels and Brodhead creeks. The purpose of the company is to erect a power-house a short distance between where McMichaels and Brodhead creeks join, for the purpose of furnishing both light and power for industrial purposes to Martin's Creek and Nazareth.

LEGAL NOTES.

NON-COLLECTION OF FARE ADMITTED AS EVIDENCE IN DAMAGE SUIT—A street car conductor's trip report as to fares taken is held in Callahin *vs.* Washington Water Power Company (Washington) 56 L. R. A. 772, to be admissible as evidence in corroboration of his testimony that he received no transfer on a trip for alleged injuries during which an action has been brought against the company by one claiming to have ridden in that trip, and to have paid fare with a transfer where it was made before he knew of the accident or that any question would arise as to his having taken a transfer.

STREET RAILWAY COMPANY LIABILITY—A street railway company which permits cars of another company to be run over its tracks under a mere traffic arrangement is held in Sias *vs.* Rochester R. Company (New York) 56 L. R. A. 850, not to be liable for the death of a passenger of the latter company caused by collision with a tree beside the track, although it has laid its track so close to a line of standing trees that faulty construction of a car or neglect of the management may bring a passenger into collision with them, if, by the exercise of care, they can be passed in safety.

ELECTRIC RAILWAYS.

JANESVILLE, WIS.—Work on the Rockford, Beloit & Janesville interurban electric line is being rushed, and cars will be running by the fifteenth of next month.

ALEXANDRIA, IND.—The Hartford City & Alexandria Traction Company has accepted the franchise granted by the city council. It proposes to build a line between the two cities as soon as possible.

MUNCIE, IND.—The Union Traction Company was recently granted a franchise to extend its system from Dalesville to Middleton, and another franchise to extend the system from Muncie to Alexandria.

TACOMA, WASH.—The Hoquiam & Aberdeen Street Railway Company has issued bonds to the amount of $125,000, the proceeds to be used in building an electric line between the two chief towns on Gray's Harbor.

HUNTINGTON, L. I.—It is rumored that a trolley road is to be constructed between this village and Amityville. Surveyors are at work between Amityville and Fair Ground. A branch road from Farmingdale to Hicksville and Oyster Bay is part of the plan.

BALTIMORE, MD.—The Virginia Passenger and Power Company has bought the Richmond & Pittsburg Electric Railway for a price said to be around the half-million mark. The road is twenty-two miles long, and forms a connecting link between the street railways of Richmond and Petersburg.

EVANSVILLE, IND.—The Evansville, Boonville & Rockport Railway Company has asked the board of public works for right of way into the city, and also for a right of way through the county to the Warwick County line. The company has been financed and will begin a survey as soon as the rights of way are secured. The company is composed of Evansville men.

EAU CLAIRE, WIS.—At a conference held recently by President Appleyard, of the Chippewa Valley electric railroad, and President Barber and other members of the Eau Claire Commercial Association, plans were outlined for an electric railway to connect Eau Claire and Menominee. Mr. Appleyard is also considering the project for an electric railway connecting Eau Claire and Mondovi.

HARRISBURG, PA.—Work on the Harrisburg & Lewisberry street railway has been commenced. The new line will extend from Lewisberry to New Cumberland, which point is already connected with Harrisburg. When the line from York to York Haven is completed, it is probable that York Haven will be connected with Lewisberry, and that will connect York with Harrisburg.

BLAIRSVILLE, PA.—Another company has been formed to build an electric line between this place and Indiana. Its plan is to build a line between Indiana and Blairsville intersection, taking in the towns of Twolick, Homer City, Graceton, Coral, Blacklick, Blairsville and Cokeville. The capital is fixed at $115,000, and the directors are: J. N. Langham, D. E. Thompson and A. F. Cooper, the latter of Homer City.

FRENCH LICK, IND.—Thomas Taggert and Bernard J. T. Jeup, of Indianapolis; L. T. Dickinson, of Chicago; Thomas B. Buskirk, of Paoli, and Crawford Fairbanks have incorporated the New Albany, Paoli & French Lick Traction Company, to build an electric line from New Albany through the towns of Orange, Washington, Harrison and Floyd counties, with French Lick as a terminus. Franchises have been secured from all towns with the exception of New Albany, and it is not expected that there will be any difficulty here. The capital stock has been placed at $100,000.

CARTERSVILLE, MO.—At the annual meeting of the stockholders of the Southwest Missouri Electric Railway Company, the directors of the company were reelected as follows: E. Z. Wallower, A. G. Knisely, Edward Bailey, H. L. Hershey, Edward S. Herman, all of Harrisburg, Pa.; W. B. Meetch, Millersburg, Pa.; S. McReynolds, Carthage; A. H. Rogers, Joplin. The officers elected were: A. H. Rogers, president and treasurer; E. Z. Wallower, vice-president; A. G. Knisely, secretary. The entire management of the road is unanimous in the desire to extend the system as rapidly as possible, and plans for extension were discussed and practically agreed upon. The road to Carl Junction will be pushed forward rapidly provided franchises are granted, which is almost assured.

INDUSTRIAL ITEMS.

THE NEW YORK TRADE SCHOOL has prepared a course of ten lectures for journeymen electrical workers beginning on Friday, October 31, and continuing on each succeeding Friday, including March 13, 1903.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is selling large numbers of Packard "Mogul" lamps. The company claims that this lamp has a great many excellent characteristics for service in the incandescent or so-called incandescent arc lamp field.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., commemorative of the Street Railway Convention at Detroit, presented its friends with an attractive souvenir descriptive of a trolley trip to the Rochester power-house over the Flint division of the Detroit United Railway.

THE MASSACHUSETTS FAN COMPANY, Waltham, Mass., in bulletin No. 58 describes and illustrates the Davidson electric propeller fans, constructed with direct-current electric motor. The bulletin also describes the Davidson electric propeller fan with alternating-current motor.

G. M. GEST, conduit contractor, New York city, has been awarded the contract for all of the underground conduit work to be installed by the Brooklyn Heights Railroad Company this season. This contract amounts to over $25,000. He is presenting his friends with an attractive catalogue descriptive of conduit work.

THE PAYNE COMPANY, Elmira, N. Y., in bulletin No. 32 describes the Payne engines, supplementing the text with fine half-tone illustrations. The details of these engines are carefully worked out, and sectional reproductions increase the value of the catalogue very much.

MR. A. H. MUSTARD, advance agent for a number of electrical specialties, is distributing a booklet entitled "Packard's Electrical Arena." This contains more or less light talk which leads up to the fact that genuine Packard lamps are all that can be desired by prospective purchasers.

THE CHICAGO PNEUMATIC TOOL COMPANY, Franklin, Pa., has produced a fine catalogue descriptive of its air compressors and compressed air apparatus. A large number of well printed half-tone reproductions of machinery and parts is supplemented by a great deal of useful information in regard to compressed air service.

MR. FRED M. LOCKE, Victor, N. Y., illustrates in catalogue No. 6 a very complete line of insulators. This represents the result of many years' experience in the manufacture of this class of work. The company has been making constant study to attain the highest degree of mechanical and electrical perfection in the construction of its insulators.

THE FIFTH AVENUE THEATRE'S new entrance, which will be opened November 15, has been entirely refitted under the personal direction of Mr. J. Austin Fynes, general manager of F. F. Proctor's enterprises. Handsome decorations and a new plan of electric lighting will be adopted, and many special innovations in this direction will be applied in service.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has ready a fine new chain catalogue, which it will be pleased to send to any one interested upon application. The Jeffrey Manufacturing Company is the maker of chain belting, elevating and conveying machinery, electric and air power coal mining plants, and mill and mining supplies of every description.

THE BRADY BRASS COMPANY, Jersey City, N. J., had one of the most interesting exhibits in the recent street railway convention, in charge of Mr. Daniel M. Brady, president. This company manufactures a fine line of brass goods, armature axles, journals and motor bearings. Its well-known product, cyprus bronze, is widely advertised as running cool in the Arrow, the fastest yacht afloat.

SARGENT, CONANT & COMPANY, Boston, Mass., will shortly complete the electric power and lighting equipment of the Hampton Company, of Easthampton, Mass. The entire plant will then be

electrically driven, current being supplied from two multiphase generators, one direct-coupled to a Corliss type engine and the other belted to a water-wheel, either or both being used as desired for operating motors, arc or incandescent lamps.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., will be pleased to send upon request a booklet describing its graphite pipe joint compound. This flake graphite is claimed to be impervious to the action of heat or cold, acids or alkalis, and a graphite paint when properly used is of great value to the steam fitter and engineer. Samples will be sent with the booklet if desired.

THE VINDEX ELECTRIC COMPANY, Chicago, Ill., is placing on the market a transformer especially designed for the operation of a single arc lamp. This is furnished in what the company calls its style "H". This transformer is claimed to operate at an unusually high frequency and regulating with great satisfaction, having only a slight rising of temperature, operating continuously under a load.

THE STANDARD TRACTION BRAKE COMPANY'S exhibit of apparatus at the Light Guard Armory, Detroit, Mich., was one of great completeness. The manufacturer of this apparatus, the Westinghouse Air Brake Company, Pittsburg, Pa., has issued a leaflet describing in detail each part of the thirty-two exhibits. This makes very interesting reading, and is a liberal education as to what is necessary in this class of service.

THE LINK BELT ENGINEERING COMPANY, Philadelphia, New York and Pittsburg, and the Link Belt Machinery Company, Chicago, have printed a pamphlet describing and illustrating the Renold silent chain gear in connection with electric motors. This chain gear has been on the market in this country not quite a year, but its extended application is showing the great service which is found available with its use. The bulletin, No. 1,001, may be had upon application.

THE PITTSBURG BLUE-PRINT PAPER AND MANUFACTURING COMPANY was represented by S. B. Whinnery, secretary and general manager, and Robert Gibson at the street railway convention. This company exhibited something new in an automatic transfer printing device which prints transfer tickets automatically, giving the name of street where transfer is made, together with time, day of week and date. It is locked by the starter before each trip, and is claimed to be absolutely "untamperable."

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., general selling agent for the new type Peerless incandescent lamps, states that owing to the popularity and exceedingly large demand for this lamp, the factory has largely increased its capacity recently, and while it is making even better lamps than ever, on account of the very greatly increased facilities, it is offering this lamp at a slightly lower figure than ever. The company states that this lamp is thoroughly high grade in every way, and has met with unusual success with it.

THE TANITE COMPANY, Stroudsburg, Pa., is distributing some interesting literature descriptive of the properties and application of the Tanite emery wheel. A recent test is described, wherein a wheel thirteen and one-half inches in diameter by two inches in thickness, running for one-half hour at the rate of 1,630 revolutions per minute, ground off thirteen pounds two and one-half ounces of cast iron. During the same half hour an expert workman, filing steadily, removed six and three-quarter ounces of cast iron. Information will gladly be sent upon application.

THE SPRAGUE ELECTRIC COMPANY held its annual stockholders' meeting on Tuesday, October 14, at the office of the company in Watsessing, N. J. The following directors were elected for the ensuing year: Messrs. Allan C. Bakewell, D. C. Durland, S. M. Hamill, J. R. Lovejoy, John Markle, J. R. McKee and E. G. Waters. At a meeting of the board of directors held later in the day, officers were elected as follows: President, Allan C. Bakewell; first vice-president, S. M. Hamill; second vice-president, D. C. Durland; secretary and treasurer, Harry R. Swortz.

THE ALBERGER CONDENSER COMPANY, 95 Liberty street, New York city, has, among a number of recent orders for high-vacuum condensing apparatus, secured the following: Belt Light and Power Company, Pennsylvania Sugar Refinery, Sharon Steel Company, Port Huron Light and Power Company, Hartford Street Railway Company, Binghamton Light and Power Company. The equipment for these plants consists of Alberger barometric or surface condensers, with improved vacuum or circulating pumps, and the necessary appurtenances for securing the high vacuum required by the use of steam turbines, which are being installed in most of these plants.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has installed a complete battery equipment at the residence of Mr. A. G. Vanderbilt at Oakland Farm, Portsmouth. This company distributed at the street railway convention a booklet illustrating installations of the chloride accumulator as operated in the street railway service. A brief preface stating the increase in the installations of this accumulator from October 1, 1901, to October 1, 1902, is followed by eleven half-tone illustrations of the interior of several battery houses with a brief synopsis of the different installations made for the railway companies represented.

THE MARSHALL-SANDERS COMPANY, Boston, Mass., reports that its automatically produced sockets have become very popular and that there is a great demand setting in for this apparatus. The company is promptly filling large orders for these sockets, and will be pleased to give full information to any one interested. It is presenting its friends with a very attractive calendar, starting with October, 1902, and running to December, 1902. This calendar is adorned with a handsome reproduction of a plastique relief by Albert Lenz, entitled "The Flight of Time," and comes out just at a time when those calendars which are issued early in the year are becoming so soiled as to need replacement.

THE CHARLES E. DUSTIN COMPANY, 11 Broadway, New York city, announces that it has an attractive line of electrical and steam machinery for immediate delivery. The company has recently secured a commodious and complete storehouse property at Orangeburgh, N. Y., located on the West Shore and Erie railroads, about an hour's ride from New York city. This has been put in charge of Mr. George Esslinger, an electrical and mechanical engineer of long experience. The company now has excellent facilities for handling apparatus and putting it into first-class condition, and it is also prepared to purchase in any quantity and store until such times as it may be wanted, exceptional pieces of apparatus.

EUGENE MUNSELL & COMPANY and the Mica Insulator Company were represented at the street railway convention by Charles E. Coleman, manager for both concerns at Chicago. Mr. Coleman had a prominent location in the centre of the hall, in the space selected by William Wharton, Jr., & Company, of Philadelphia. Micanite and Empire insulating materials were exhibited in various forms, and the companies' circular matter was distributed. This included a blotter which was also used in the writing rooms of the various hotels. This company reports an extensive demand for Micanite specialties, and has just completed additions to its works at Schenectady which will give an increased capacity of 6,000 square feet of floor space.

THE AMERICAN CARBON AND BATTERY COMPANY, St. Louis, Mo., which originally only manufactured carbon cylinders and dry-battery plates, has recently commenced the manufacture of telephone specialties. The company states that it is unable with its present machinery to supply the orders now in hand. This has necessitated putting in additional machinery, which it hopes to have ready for operation in thirty days. A machine which is being constructed in St. Louis is an automatic hydraulic press capable of exerting a pressure of 15,000 pounds to the square inch. This machine is of new design and is so constructed that it will make moulding dry-battery plates, motor brushes and telephone specialties, and the company anticipates its production being very popular in this line of apparatus.

THE WESTINGHOUSE ELECTRIC MANUFACTURING COMPANY has recently secured an order for a large amount of electric apparatus to be used for the operation of wood-turning machinery for the Illinois Car and Equipment Company, of Heggewisch, Ill.; this contract includes two 250-kilowatt and one 200-kilowatt, two-phase alternators, together with a four-panel switchboard, and two 100-horse-power, five 75-horse-power and one 50-horse-power induction motors. The Steel Storage and Elevator Construction Company has adopted electric power distribution for a large grain elevator for the Canadian Pacific Railway at Fort William, Ontario, and a recent purchase includes a direct-current generator and a number of direct-current motors. The Browning Engineering Company, of Cleveland, Ohio, has purchased a number of railway type-train motors, ranging from twenty-five to fifty horse-power.